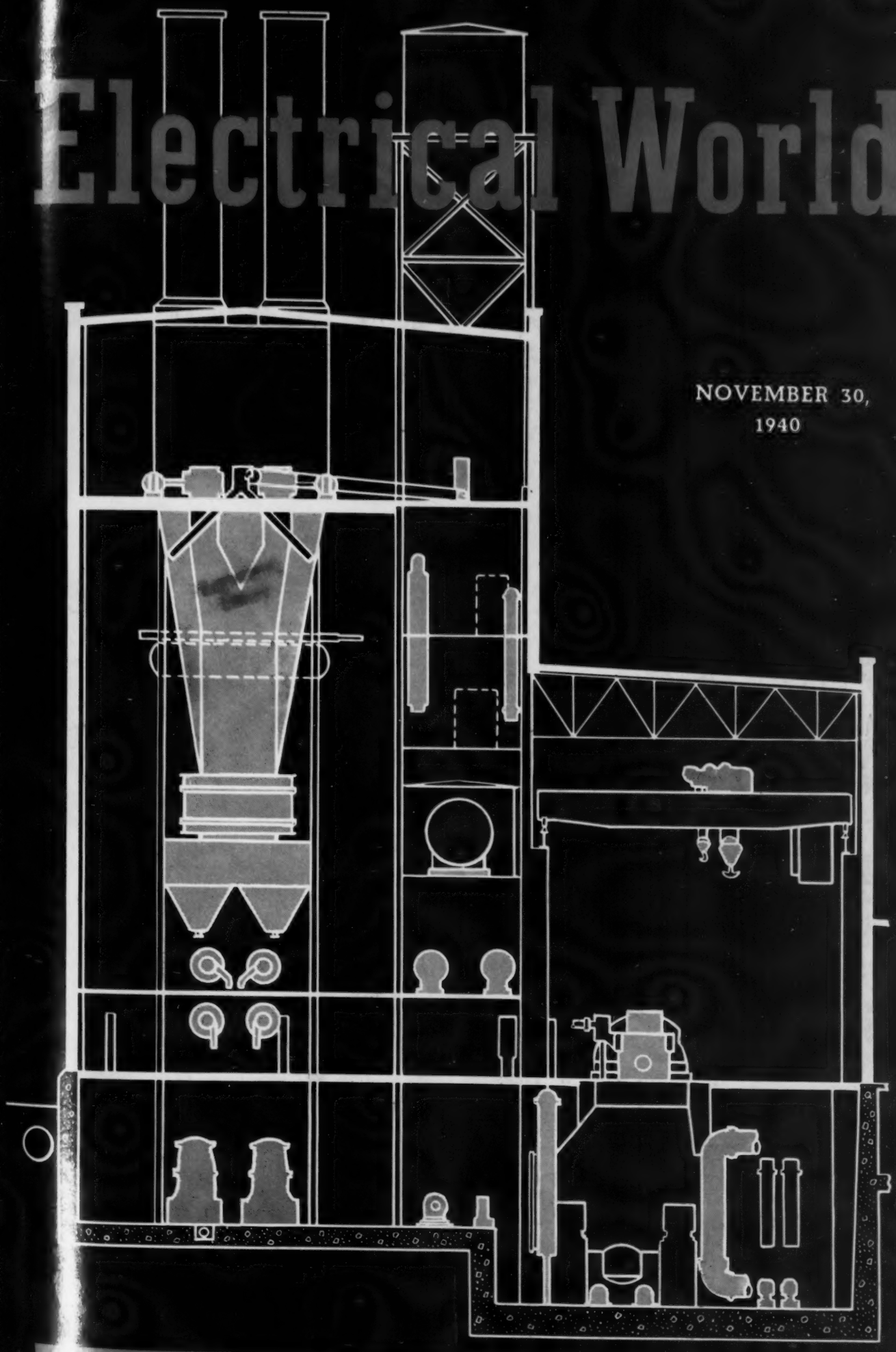
Electrical World

NOVEMBER 30,
1940



1940 DESIGN TRENDS IN STEAM CAPACITY

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Synthetics are not Substitutes

Intrinsic merit—the ability to obtain qualities which natural products do not possess and thereby broaden the field of usefulness of insulated wires and cables—has been the reason why we have devoted so much time for so many years to intensive study and practical application of such synthetics as Neoprene, Koroseal, and Thiokol. These are the rubber-like compounds which chemists prefer to call "elastomers" and "plastomers." Each of them possesses characteristics which enable us to use them in the making of insulations or protective coverings unlike anything available before.

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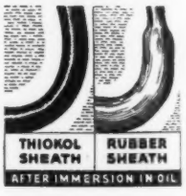
Thiokol is oilproof and moisture-proof. Oilproof coverings of Thiokol prolong the life of Okonite insulation in many important industrial applications.



These examples are typical of the possibilities opened to us as manufacturers of electrical wires and cables through the development of these synthetics. » » » Nor is the end in sight. The field appears almost limitless and from its further development, we confidently expect our research workers to add still more important new Okonite products, which will meet new and even more exacting requirements. The Okonite Company, Passaic, New Jersey, offices in principal cities.

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INSULATED WIRES AND CABLES

The Greatness of America

As a sort of tonic to a people worn out by a strenuous presidential campaign the United States is receiving a large dose of publicity on the greatness of America. It's not bad medicine if the right ingredients are used and if it is properly administered.

America isn't great because of what it has, but because of what it does and the way it does it. Our great natural resources of field, forest, mine and water are real assets, but they do not per se make America great. Russia, China, Africa and parts of South America are also richly blessed by nature, but their peoples do not have what we Americans have. Nor do our per capita possessions in income, real estate, telephones, automobiles, electricity, etc., make this nation great. They are but material results.

What has made America great is the driving force of incentive. The freedom to take oil and minerals from the ground, power from the streams, wheat from our prairies, to fabricate goods, to open a store and make a profit, sometimes a fabulous profit, has made this a land of opportunity. It is the incentive springing from the richness of this opportunity that gave us the strength, vitality and action that made this country great.

And in all this saga of American greatness nothing stands out any stronger nor has contributed more to this general well-being than electricity. Less than sixty years old as an industry, electricity has made our labor the most productive in all the world and thus brought to all the people a harvest of products that anywhere else would be luxuries to be owned only by the rich. And by thus increasing productivity, electricity has helped American labor to be the best paid in the world. Thus has electricity laid the foundation in this country for the world's highest standard of living.

The conveniences of comfortable living—lighting, cooking, washing, ironing, cleaning, food preservation; the vertical and horizontal transportation facilities of skyscraper cities; the pleasures of the movies and modern stage; greater educational opportunities through radio; —all of these things electricity has done and at a cost less than that of the service replaced.

None of these came from government—all grew because men had an opportunity to make money. And in this search for the golden reward the men who built the electrical industry made money for others and great wealth for the United States. The forests that gave up their poles, the mines that yielded the metals and coal, the fields that produced the cotton, the factories that fabricated these products, both for use by the utilities and by the consumers, all profited and America further prospered.

And this great universal servant, through the integrity of its securities, became one of the principal investment bases of our insurance companies and savings banks, and in that way has been instrumental in encouraging thrift.

So, when we talk of the greatness of America, let us tell what our contribution has been. Let us tell why it is possible for American labor to work but 40 hours a week and still maintain our national productive capacity; let us tell why American women have less of the drudgeries than their sisters abroad; let us tell why we have such great opportunities for education and amusement.

Yes, America is great, and so is the industry that more than any other helped America to be great.

Utility Act Can Be Made to Work With Co-operation*

This first utterance before the utility industry of the recently appointed chairman and president of the Standard Gas & Electric Company is especially significant at this time because as head of the Federal Deposit Insurance Corporation, a New Deal agency, Mr. Crowley is known to have the ear of the President. Except for some opening remarks, we print the address in full. The italics are ours.—EDITOR.

LEO T. CROWLEY

IN UTILITIES REGULATION, as in so many other branches of social legislation, we of Wisconsin were pioneers. During the past 25 years the state consistently has taken the lead in adopting measures to protect the public interest. We know that state supervision of utility operations has generally had a wholesome effect and has benefited both consumers and security holders.

But geographic expansion of utility systems across state lines and corporate complications resulting both from the nation-wide distribution of utilities securities and from creation of holding companies created problems that were beyond the power of state regulatory bodies to cope with. There was a real need for federal supervision of the interstate and national aspects of the growing industry. It is the vast body of legislation enacted since 1933 to meet that need that perplexes so many of us today.

I have spent many years in business and banking and in various branches of the public service, including that charged with supervision of banks. Next to the public utilities, banks are the branch of our business life assumed to be nearest to public institutions and most subject to supervision by public agencies. I have served in Washington during the entire period of growth of the concept of federal responsibility for regulation of the utility industry. I have seen enacted during that period a body of banking laws commensurate in size and equal in novelty to the volume of new utility laws. It has been my daily task to join in the processes of give and take that finally have adapted our banks comfortably to operations under the new statutory rules. *Much of what has been done with the banks remains to be done with the utilities.* I hope, therefore, that in my development of a suggested program for this industry I shall be permitted to draw frequently upon my experience of the past several years and to make certain analogies.

Public Interest

To my mind it is essential at the outset to recognize two things about governmental supervision of business enterprises such as utilities and banks. In the first place, government has a clear and definite responsibility to protect the public from dissipation of its wealth by corporations whose existence government sanctions when it issues a certificate of convenience and need. Secondly, the extent of supervision by government always has depended upon the degree to which management itself recognized and regarded the public interest.

Supervision of banks always has had as its primary objective the protection of depositors from loss of their funds. Supervision of utilities has always been designed primarily to protect the people from exploitation of natural resources that are their common property and from dissipation of the savings they have invested in utilities' capital. The two objectives are identical in spirit. Changes in the two procedures have occurred as attainment of the objectives became more difficult. In both cases stricter and more detailed supervision has come about in answer to popular demand because of managerial abuses and governmental laxity. How could we expect bank depositors to accept quietly the loss of nearly two billion dollars of their funds through bank failures? Why should consumers and investors not have insisted on governmental attention to the many weaknesses which had become serious in the utility field?

Limitations of States

I believe that state regulatory bodies did as well as they could to discharge their responsibilities. The difficulty was that we failed to recognize that the *states were unable to combat effectively the abuses arising from interstate business and from absentee ownerships.* Had we had strong federal supervision during those years, had we had a body able to coordinate activities of the state commissions and to apply an over-all view to the situation, I am convinced that the utilities themselves would today be on a much sounder footing and that both consumers and investors would be immeasurably better off.

Hesitancy to broaden the field of regulation during those years is easily understandable. Our traditions of free enterprise and state's rights are formidable barriers to the growth of federal powers, just as friendship and other interests make difficult the achievement of reforms within our smaller political units. Government has always preferred to keep the boundaries of regulation broad, allowing management great freedom of action within those bounds. *I can't recall a single case where an attempt was made to regulate just for the sake of regulation.* This hesitancy to circumscribe too closely I consider quite consistent with our democratic

* Paper presented before the Wisconsin Utilities Association Convention, Nov. 11, 1940.

ideals. But experience has shown it to be expensive in the light of some of our democratic practices.

As is true of all major reform legislation in our history, the banking and utilities legislation of recent years has been curative rather than preventive. Rare is it indeed that we provide against the possibility of misfeasance until that possibility has been abused to the point where our people insist upon remedial action.

Rights and Limitations

With respect to all legislation, there are a few fundamental facts that often are forgotten by the government and the governed alike. Those charged with administration of legislation have as their sole responsibility to see that the law is carried out. *Their prerogatives include no authority to add to or subtract from the scope of legislation, no room for the arbitrary application of their pet theories. Similarly, the executives of corporations have no right to defy laws that happen to conflict with their personal views. Their only proper course is co-operation with administrative authorities in the public interest, relying upon due process of law for the adjustment of grievances.* If democracy means anything, it means that the good of the whole people must be the primary concern of each of us. It means, equally, that nothing that is in the public interest ultimately can react to the disadvantage of any of us. Bad and impractical legislation occasionally is enacted, but laws that are really bad and impractical invariably are short-lived, because they do not best serve the public interest and are soon amended or discarded. By the same token, utility management must realize that it can properly serve the public interest only by maintaining the highest financial and industrial standards, even though the letter of the law does not require them to be maintained.

I am not reciting platitudes when I urge co-operation and joint discussion between government and governed for the resolution of differences. I know that they will work, and that workable sets of laws can come out of them. Let me turn for my proof to the banking field.

The Banking Act of 1933 was quite as revolutionary in its scope as anything then or since passed that affects utilities. It was admittedly a hastily drafted and hurriedly passed piece of legislation, noble in purpose but thoroughly impracticable in many of its provisions. Its weaknesses were admitted much more readily by those charged with its administration than were its good points by those whose operations it would affect. Yet action was imperative. There was little time for sulking or protesting and no time for obtaining amendments. So we all set about the business of working harmoniously together.

There was no part of our financial or business system so weak or so vulnerable as were the banks in 1932. The collapse of 1933 showed that public confidence in the banks had disappeared completely. Administrators and bankers, therefore, sat down together and decided to go at first things first. Financial rehabilitation, with the aid of more than a billion dollars of RFC capital and a nearly commensurate amount of new private capital, was the first step in our program. And in it the majority of bankers co-operated whole-heartedly. Rehabilitation of public morale through institution of federal deposit insurance was the next step, and even in adopting so unique an innovation as this the bankers subordinated their individual prejudices to the public interest.

Remedial Legislation

Thus was the task of immediate rehabilitation undertaken and accomplished. Then we turned jointly to the problem of needed reforms and to the need for clarification and amplification of the emergency laws. From our co-operative efforts came the Banking Act of 1935, a comprehensive, workable statute which, with other laws, accomplished such vital reforms as the divorcement of security affiliates, flexible reserve requirements, prohibition of interlocking directorates, regulation of loans for speculative purposes and the establishment of deposit insurance on a permanent basis.

In the intervening years the bankers and their supervisors have continued to work together to accomplish what additional rehabilitation was needed, whether by current elimination of losses in most institutions or by actual elimination of some banks that constituted a hazard to the well-being of the whole system. The supervisors have been vigilant and impartial in the exercise of their rights and duties. The bankers have recognized their problems and worked constantly to improve their condition and their practices. The net result is that with very little cost either to the government or to the banks both rehabilitation and reform have been accomplished; the public has benefited immeasurably; the banking system is in the strongest, soundest condition it ever has enjoyed.

Can you avoid drawing a parallel? To such innovations as registration of its securities and supervision of its accounting systems the utility industry has adapted itself. Its financial condition has improved in so far as business generally has improved. *But of real rehabilitation and of basic reform there have been little.*

Preferred Stock Arrearages

Of the need for rehabilitation? *Drastic financial reorganization of holding companies and operating companies that are burdened with huge preferred stock dividend arrearages is inevitable.* On the basis of the latest published figures (as of January 1, 1938) out of 158 holding companies having outstanding preferred stocks with a par or liquidating value of about $2,400,000,000, there were 48 companies with outstanding preferred stock (in the hands of the public) amounting to $1,331,000,000 which were in arrears as to dividends to the extent of about $337,000,000. On that date, therefore, the arrearage represented an average accumulation of more than 25 per cent of the par value of the stocks.

Among the operating subsidiaries of registered holding companies there were found 224 companies with preferred stocks in the hands of the public amounting to $1,447,500,000. Of these, 70 companies had accumulated arrearages of about $96,000,000 on their outstanding preferred stocks in the amount of $443,000,000. Thus more than 30 per cent of the preferred stocks of the operating companies was in arrears to the extent of 21.6 per cent.

This picture has improved during the intervening three years, but the magnitude of the problem is still considerable. *If funds are to be obtained by these companies for replacements, for needed expansion of plant and distribution facilities, or*

[*Continued on page 119*]

Series Capacitors for Distribution Regulation

Voltage regulation instantaneous and automatic — series capacitor, while not a complete panacea, can serve to improve system power factor simply and inexpensively

W. H. CUTTINO,* Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

VOLTAGE regulation is of primary importance in the distribution of electrical service. The regulation which occurs between the generating station and the users' premises is due to the circuit impedance; a major portion of this is inductive reactance. Since series capacitors can be used to nullify the effects of line reactance, it is obvious that they should be considered along with voltage regulators, large conductors, higher voltage, and shunt capacitors, in solving voltage regulation problems.

The characteristic of instantaneous correction obtained by the use of series capacitors cannot be duplicated by other regulating equipment for correcting voltage dips caused by rapidly varying load currents. This makes the series capacitor a very important tool for correcting lamp flicker problems as it is only competitive with the cost of additional distribution circuits, or in some few cases a motor-generator set. It is also a useful and economical method of improving voltage regulation on small low-current distribution circuits where the load power factor and the ratio of line resistance to line reactance is not unusually high.

Application

As a voltage regulator, the series capacitor responds only to the current through it to the load beyond, and therefore will not respond to system voltage variations originating ahead of it. It is a current-operated device and is practically instantaneous and automatic in operation, since it introduces a voltage which leads the current by 90 deg. and is directly proportional to the magnitude of the current. As a result, the leading negative reactance voltage of the capacitor cancels the lagging line reactance voltage for all values of line current. If the ratio of line resistance to line reactance of the circuit is low, the series capacitor provides effective compensation for line drop over a wide range of load power factor and the device provides a well-regulated voltage provided the bus voltage is maintained constant. If load power factor is low and almost constant for all values of load current, a series capacitor can overcompensate for the inductive reactance drop in the line in order to compensate totally or partially for the resistance drop of the line.

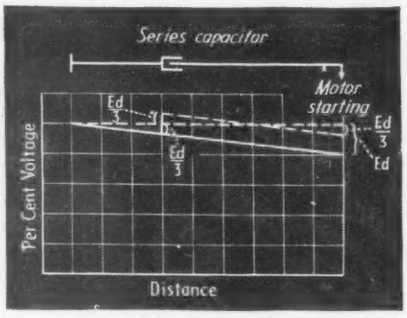


FIG. 1—SERIES capacitor can cut flicker voltage to one-third

By placing a series capacitor about one-third of the electrical distance between source and load voltage on both sides is held within limits small enough to prevent lamp flicker.

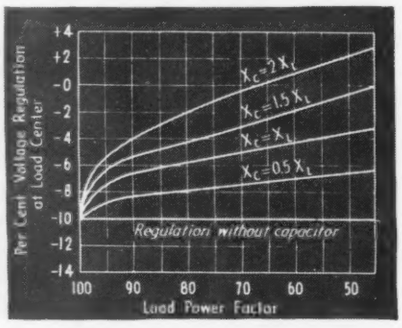


FIG. 3—VOLTAGE regulation with series capacitor of various sizes and with varying load power factor

For line with $R/X = 1$ and with voltage drop of 10 per cent without capacitor.
X_c = series capacitor ohms
X_L = line reactance ohms

Line inductive reactance is most detrimental to good voltage regulation when load currents of poor power factor flow in the circuit. The series capacitance reactance gives the greatest voltage corrective effect when the load power factor is poor. The compensation of the line reactance with capacitance reactance reduces the circuit impedance, thus permitting the carrying of greater loads with the same voltage regulation tolerance or the same load with improved regulation, which makes it a useful and economical method of voltage improvement on small low-current distribution circuits where more expensive regulating equipment is not justified.

Lamp Flicker

The characteristic of instantaneous operation cannot be duplicated by other regulating equipment for correcting lamp flicker caused by rapidly varying load currents, such as produced by frequent motor starting, electric welders, electric furnaces, electric shovels, and similar equip-

* Capacitor engineer.

ment. Other forms of voltage-regulating devices require a change of voltage to actuate them and then some time to make the correction. Frequently by the time such correction is made the excess current demand has ceased and an overvoltage results. The series capacitor is, therefore, ideally suited for correcting lamp flicker caused by rapidly fluctuating loads and is competitive only with the cost of building an additional distribution circuit or the use of motor-generator sets.

Location of Capacitor

When considering the use of series capacitors it must be remembered that the line inductive reactance for which the capacitor is to compensate is distributed along the length of the circuit. If loads are taken off at several points along the circuit the capacitor must be so located that the current to the rapidly fluctuating load and the loads to be benefited will pass through the capacitor. The best location of the capacitor is usually determined by a cut-and-try method, taking local factors, such as load distribution, into account. In general, the best location is about one-third of the electrical impedance distance from the source of supply.

A given flicker can be cut to about a third by the use of a capacitor (Fig. 1). If cutting the flicker to a third of its original value is insufficient, then a still further reduction can be obtained by installing series capacitors at two or more locations without any possibility of hunting, such as might occur with conventional regulators. If load is taken off at one point only the location of the capacitor is not so important and better compensation can be obtained.

Series Capacitor Ratings

In selecting the series capacitor rating, determine the maximum normal line current, the expected fluctuating load current and their respective power factors and using the line resistance and reactance values back to a point in the circuit where the voltage regulation is negligible, determine the full-load voltage levels along the line at various loading points. The ohmic capacitance reactance required to produce the desired voltage at a certain load power factor for a given location can be determined analytically, or the approximate value can

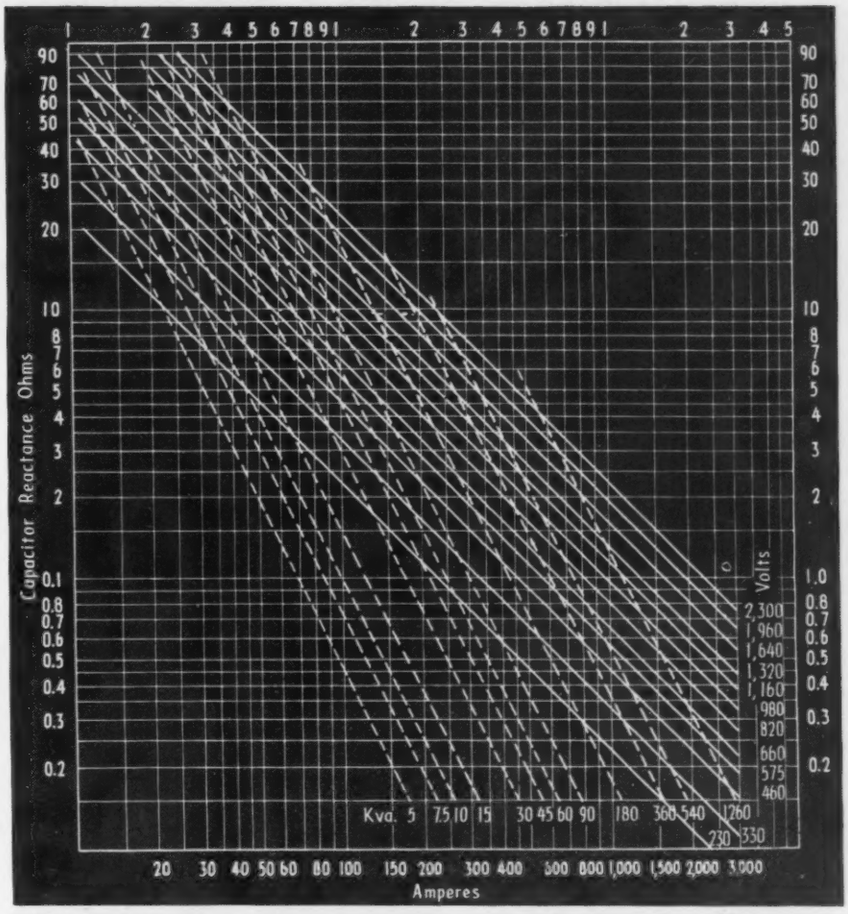


FIG. 2—CHOICE of series capacitor rating

Suppose 15 ohms with a normal rating of 30 amp. is selected tentatively. Follow the 15-ohm line to the intersection of the 30-amp. vertical line. No voltage line crosses at exactly this point; therefore, go to the nearest voltage line above this, which is 460 volts, and follow this down to the nearest kva. line, which is 15. Where the 460-volt and 15-kva. lines cross would give an ohmic rating of 14 with a normal current rating of 33. Therefore, a 15-kva., 460-volt, single-phase capacitor could probably be used. It would have an ohmic rating of 14 with a current rating of 33 amp.

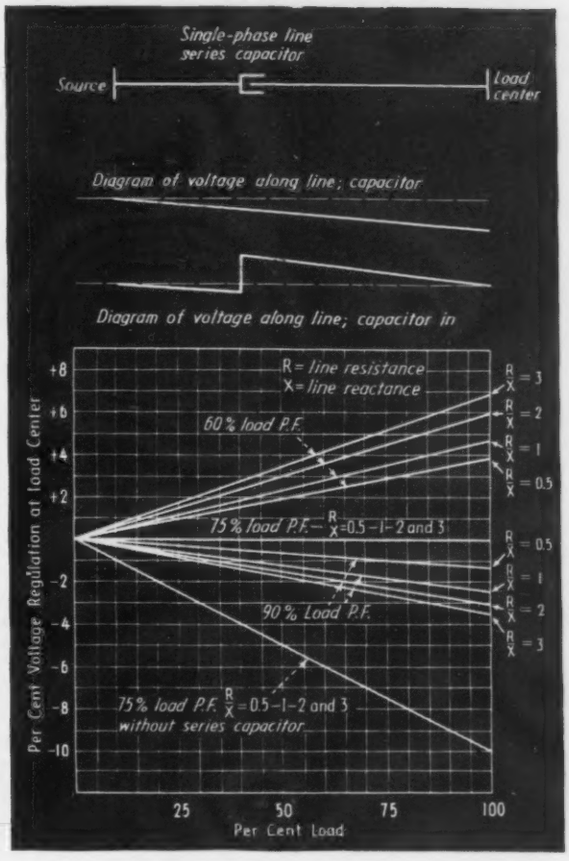

Single-phase line series capacitor
Source
Load center
Diagram of voltage along line; capacitor
Diagram of voltage along line; capacitor in
R = line resistance
X = line reactance
60% load P.F.
75% load P.F. R/X = 0.5 - 1 - 2 and 3
90% Load P.F.
75% load P.F. R/X = 0.5 - 1 - 2 and 3 without series capacitor
Per Cent Voltage Regulation at load Center
Per Cent Load
25
50
75
100

FIG. 4—VOLTAGE regulation at load center for load power factors of 60 and 90 per cent lagging. When series capacitors are added to compensate at a load P.F. of 75 per cent lagging for both line resistance and reactance.

be determined by the formula:

$$X_c = \frac{E}{I \times \sin \Theta}$$

where

E=Line to neutral voltage rise desired on three-phase circuits or line to line voltage rise on single-phase circuits.
I=Phase current in amperes.
Θ=phase angle between load current and voltage.
X_c=capacitance reactance required per phase.

However, since it is necessary that some change in voltage be permitted at intermediate points, the simplest procedure is usually to cut-and-try, taking into account variations in load power factor with varying loads.

Curves shown in Fig. 2 can be used to determine quickly the rating of the capacitor units in series with the line once the continuous currents and ohmic ratings have been tentatively selected. Momentary current, such as during motor starting, should not exceed normal rating by more than 50 per cent. In other words, the normal continuous current rating of the capacitor should not be less than two-thirds of the momentary currents during motor starting.

Voltage improvement can be obtained by adding capacitance whose values vary from one-half the line reactance to twice the line reactance for load power factors varying from unity to 45 per cent lagging (Fig. 3). The values shown are for full load current condition for a circuit that has 10 per cent voltage drop before adding series capacitors.

In selecting a series capacitor to compensate for line reactance, load distribution along the line and variation of load power factor should be studied carefully, for they affect voltage regulation, as illustrated in vector diagrams of Fig. 5 and the curves of Fig. 4. Although the vector diagrams, Fig. 5, and the curves, Fig. 4, show that it would be possible to add sufficient capacitance ohms to eliminate circuit regulation at a given load power factor, consideration of the varying power factors of a circuit indicates that it would be inadvisable to go too far in over-compensation.

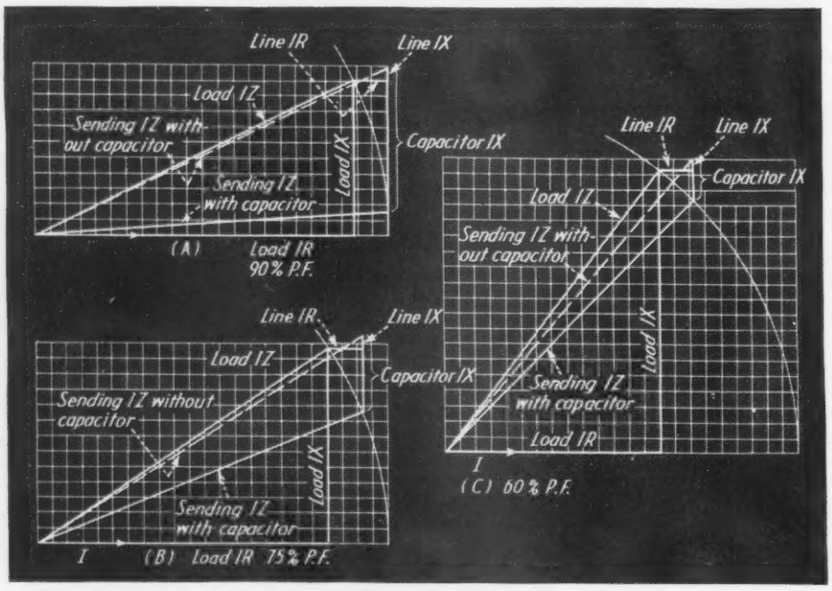


FIG. 5—VOLTAGE across series capacitor to obtain load-center voltage equal to sending voltage for load P.F. of 60, 75, 90 per cent lagging

Based on circuit impedance being of a value which would give 10 per cent voltage drop at the load center for full load current of 75 per cent power factor. In varying the ratio of line resistance to line reactance the line impedance was held constant so that the voltage drop without the capacitor would be 10 per cent. For the different ratios of line resistance to line reactance shown, the capacitance ohms was selected to give zero regulation for a load power factor of 75 per cent. One cluster of curves shows how much the voltage regulation changes for the different ratios of line resistance to reactance if the load power factor increases from 75 to 90 per cent with the load current remaining the same. Another cluster of curves shows how much the regulation changes for different ratios of R/x if the load power factor decreases from 75 to 90 per cent with the load current remaining the same. It is interesting to observe that the voltage at the load center increases if the load power factor drops below 75 per cent and decreases if the load power factor exceeds 75 per cent. It is also apparent that as the ratio of line resistance to line reactance decreases the voltage variation for varying load power factors also decreases.

The vector diagram, Fig. 5A, shows the voltage drop across a series capacitor added to make sending voltage the same as load center voltage when the load power factor is 90 per cent lagging. It is apparent that a series capacitor should not be added to a circuit for compensation of both line reactance and resistance on the basis of a high load power factor, as shown in Fig. 4A, if there is a possibility of encountering low power factor load conditions. It is also not usually economical to compensate for both line resistance and reactance for high power factor loads.

Advantages

The advantages and disadvantages in the use of series capacitors as compared with other methods of solving voltage regulation problems are listed briefly as follows:

1. Instantaneous in operation.
2. Current-operated and therefore automatic in correction.
3. Costs less than other methods of voltage improvement in many cases.
4. No moving parts.
5. Simple protective control may be used. There are no contacts making and breaking many times per day, as required on other equipment.
6. Several capacitors may be connected in series at different locations along the circuit without the problem of hunting, which must be considered when other types of equipment are so located.
7. Corrects voltage at distant locations on the load side of the capacitor without compensators or control.
8. Improved system power factor. Induction or step regulators or boosters are a detriment to system power factor.
9. Small space required.
10. Easy to install.
11. Costs less to install.
12. Very little maintenance or inspection required, since the capacitor has no moving parts and its protective control is not likely to be called upon to function very often.

Disadvantages

1. The regulation is affected by load power factor and, therefore is not suitable for obtaining complete compensation where the circuit line resistance to reactance is high and the load power factor varies over a wide range.
2. It does not respond to system voltage variations originating ahead of it. It responds only to the current flowing through it to the load beyond.
3. Each installation must be made for a particular set of conditions.
4. Its location must be carefully selected if loads are distributed along the circuit at several locations.
5. Each job requires engineering study.
6. Application problems.

Occasionally application problems arise in connection with series capacitors connected in distribution lines due to the constants of the entire

[*Continued on page 115*]

Conductor Ice and Wind Loads Charted

Pair of charts give ice and wind loads in terms of conductor diameter and as an increment to conductor weight per foot

J. C. BARNES, Toronto, Ont.

IN THE CALCULATION of wind and ice loading of overhead conductor it is sometimes a convenience for rough estimating and for checking purposes to have a graphical method of obtaining the total resultant load. While it is recognized that many manufacturers publish tables of these values, several entirely new types of conductor have been put on the market within the past few years, and the accompanying graphs should therefore be of use where tabulated values are not readily obtainable.

Fig. 1 shows the ice and wind loading in lb. per ft. of conductor, plotted against conductor diameter, while Fig. 2 provides a method of obtaining the total resultant load, once conductor weight/ft. and ice and wind loading values have been determined.

If assumed specific ice and wind loadings of values other than ½ in. ice and 8 lb./sq.ft. wind are desired, lines corresponding to the new assumptions can be drawn on Fig. 1. The curves of Fig. 2 will still apply to the new conditions, although the range of the chart may be affected adversely. This condition can obviously be corrected by redrawing the chart to cover the altered range.

It should be noted that Fig. 2 is still applicable, even though either wind load or ice load may be zero.

In designing these charts an effort was made to avoid unnecessary complications wherever possible, and since the only initial data required are the conductor diameter and the conductor weight/ft., it will be seen that the method is independent of the form of construction and the materials used, once the two values above have been obtained.

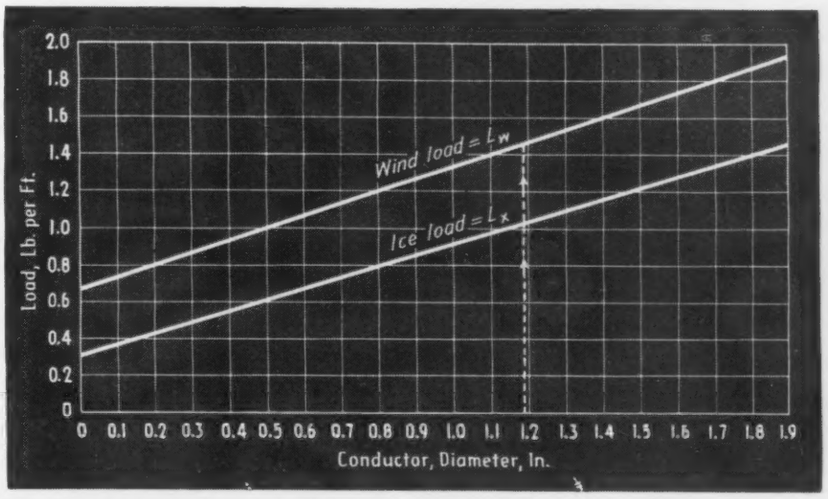


FIG. 1—LOADING in terms of conductor diameter

L_x = ice load (0.611 d + 0.311) lb. per foot
L_w = wind load (0.66 (d + 1) lb. per foot
Density of ice = 0.033 lb. per cu. in.
Ice assumed ½ in. thick all-around conductor of diameter d inches
Wind load assumed to be 8 lb per sq. ft.
Example: The arrowed lines show the determination of an ice load of 1.03 lb. per foot and a wind load of 1.46 lb. per foot on an ACSR conductor (7 steel, 54 aluminum) of 1.187 in. diameter.

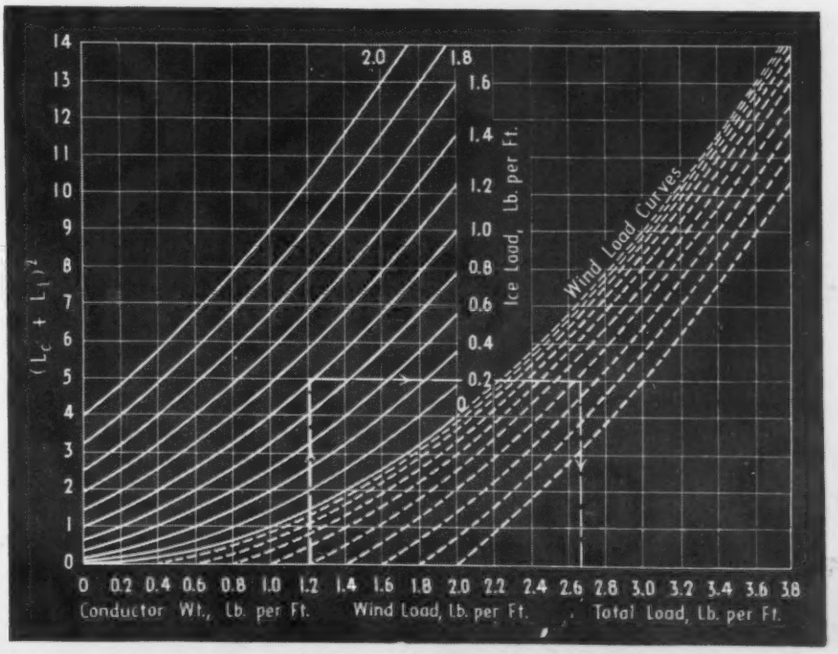


FIG. 2—COMBINED ice and wind loading of conductors

This chart adds the conductor weight per foot to the weight of ice and wind load found from Fig. 1 for the given conductor diameter. A single scale of unit weight serves for all but the ice load. The ordinate scale at the left is not used (inserted solely to show method of constructing diagram).
Total Load = $\sqrt{(L_c + L_x)^2 + L_w^2}$
Where L_c = conductor weight in pounds per foot.
and L_x, L_w are the same as in Fig. 1.
Example: Find total load on same conductor as in Fig. 1 (weight of conductor 1.206 lb. per foot). Start on abscissa scale with conductor weight 1.206, trace vertically upward to 1.03 value in ice load area, thence horizontally to 1.46 in wind load area and vertically downward to find 2.67 lb. per foot total resultant load.

BETTER

BACK in 1916 G. Fox & Co., Inc., Hartford, Conn., department store, sold merchandise under a lighting intensity of less than 3.55 ft.-candles. Today the greatly expanded establishment utilizes 21 ft.-candles in general illumination and its newly installed luminaires are designed for an ultimate delivery of 75 ft.-candles when using 900 watts per fixture. Here is an outstanding store-lighting job, with facilities for spotlighting selected displays at 300 to 500 ft.-candles from adjustable lamp units now contained inside the regular luminaires.

1 STREET FLOOR now employs 224 fixtures installed four per 20 x 20-ft. bay, 17 ft. 6 in. above the floor, and three 100-watt lamps per luminaire. Latest fixtures are type FD-1774-3M in foreground.

2 ESCALATOR LIGHTING provides about 8 ft.-candles on the rake, a relatively high figure for such work. Three to four flush plate units are installed per run, usually 8 ft. from the moving stairway and on 7-ft. 6-in. centers. Type HF-739-FL. Single lenses above rake and three lenses above landings. Present lamps, 60 watts each; units wired for 150 watts per lamp. Lenses 8½ in. square.

3 FIVE HUNDRED FT.-CANDLES, secured through "accent" or spotlights now housed within ceiling luminaires, employed to draw attention to featured merchandise.

4 BUDGET DRESSES under general and spotlighting units. Ceiling 11 ft. high. At left, 21 ft.-candles on dress from overhead fixture using three 100-watt lamps. At right, 300 ft.-candles on dress lighted from overhead fixture containing one 250-watt adjustable spotlight and two 100-watt lamps. Spotlight beam 15 deg. wide and adjustable through arc of 35 deg. from the vertical. Fixtures have cast aluminum frames and bent prismatic glass on the sides.

5 ARTIFICIAL FLOWER SHOP has six luminaires, each using a 250-watt spot or "Modelite" and two 100-watt lamps. Ceiling 11 ft. 6 in. high, general intensity 21 ft.-candles, with 300 ft.-candles on objects in concentrated beams. Supplementary fluorescent lighting at rear with twelve 30-watt tubes. Luminaire spacing in ceiling mounting, 9 ft. 9 in. by 10 ft. 9 in. Fixtures designed for ultimate use with three 300-watt lamps.

6 MEZZANINE FLOOR has low ceiling, 8 ft. 4 in. high, and is equipped with type F-1748 Controlens units with 150-watt lamps delivering 18 ft.-candles on counters, providing pleasing illumination in a difficult area.

7 AUDITORIUM SEATING 900 utilizes cove and flush lighting units, with colored lamps and spots for stage work. General lighting by 150-watt units, 20 ft.-candles. Displays of colored goods greatly facilitated by ability to emphasize qualities by selective illumination properly directed.

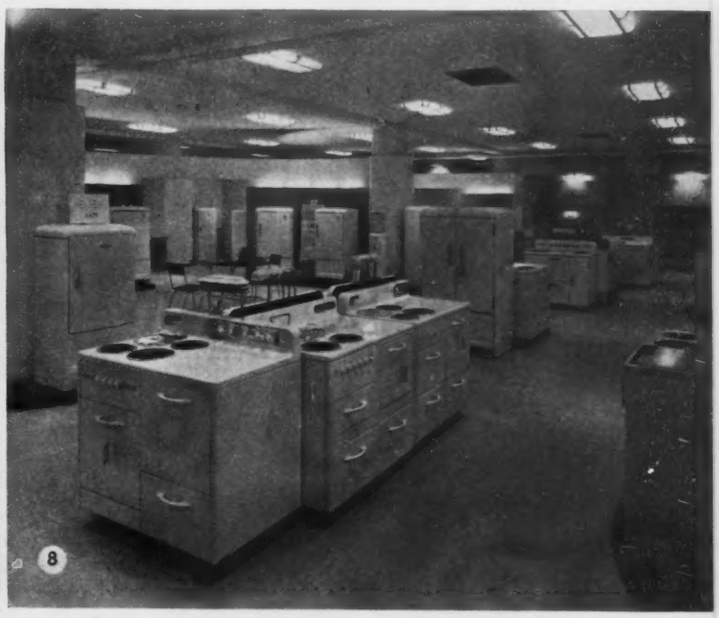
8 ELECTRIC APPLIANCES displayed under 21 ft.-candles general illumination from type FD-1774-3M luminaires using three 100-watt frosted lamps each at present, but wired for three 300-watt lamps ultimately. Ceiling 10 ft. 8 in. high, and spacing 9 ft. 9 in. x 10 ft. 9 in.

9 TROUSSEAU ROOM in period decoration utilizes crystal chandelier and type R-1894 Holophane "IN-BILT" unit of 300 watts each, set into ceiling about 10 ft. 6 in. above floor, and giving about 25 ft.-candles 3 ft. above floor.

10 INFANTS' DEPARTMENT displays wares under 21 ft.-candles obtained from "Modelite" units equipped with 250-watt spotlights and two 100-watt lamps each with units on 9-ft. 9-in. x 10-ft. 9-in. centers.

LIGHTING, LARGER SALES

Group of lighting applications, all in one large department store, illustrate for utility lighting sales engineers a variety of co-ordinated treatments, employing intensities up to 500 ft.-candles



Locating Faults on Buried Cable

Street-lighting, 4-kv. and 13-kv. buried cables require systematic testing for faults — Test schedule and method produce good operating results

R. K. WOODSON, Kansas City Power & Light Company*

IN KANSAS CITY we have installed approximately 230 miles of direct earth buried cable. Most of this cable is in operation on our street-lighting system. A small amount of buried cable is used on our 2,300/4,000-volt distribution system and we have installed approximately 9 miles of 400M-3C-15-kv. cable buried directly in the ground.

The type of cable selected for our street-lighting service is paper insulated, lead covered, protected with two spiral layers of impregnated jute and a braid of the same material. The first of this cable was installed in our system in 1921. To date this cable has had an excellent operating record. At least 99.9 per cent of our failures have been caused by external mechanical damage. Only three faults have been found which were caused by inherent defects in the cable. Electrolysis faults have been exceptionally rare.

Limit on Cost

An analysis of the cost of repairing all failures which have occurred on this cable shows that this company cannot afford to spend more than one cent per foot additional for a different cable make-up or for a different manner of installation, even if the changes would eliminate all failures. In installing this cable a special "sharpshooter" shovel, which is long and very narrow, is used in digging the ditch. Where there is a parkway between the sidewalk and curb, the cable is installed approximately 2 ft. deep next to the curb. Where the sidewalk runs to the curb the cable is buried 2 ft. deep under the sidewalk next to the curb. Augering is used exclusively to cross streets and driveways except where rock exists.

For our 4-kv. system several types of cable have been used. All of these have been of a non-metallic sheath type and have been installed similar to the street-lighting cables except that depth has been increased to 30 in. The only difficulty encountered has been in cases where a ground or neutral wire has not been included in the make-up of the cable. Failures in these types of cable have resulted in severe burning, sometimes as much as 100 ft. of cable being destroyed.

The cable which we have buried for 15-kv. service is regular paper insulated, lead covered, with three layers of jute on the outside. The first of this cable was installed in 1932 and it has had a perfect operating record except for one encounter with a ditching machine. The trench for this cable was all dug 36 in. deep with a machine, except where solid rock was encountered. Extreme care was used in handling the cable during installation and backfilling.

Location Maps

A careful record of the location of the cable is made and maps showing this data are provided. Copies of these maps are placed in each of the city departments which issue permits for street and property excavation. Each of these city departments is also provided with a rubber stamp reading, "CAUTION," "Look for Buried Cables." All excavation permits are so stamped.

Each circuit on our underground street-lighting system is "Meggered" once a month. The majority of these circuits are fed by constant-current transformers and are normally ungrounded. These circuits will operate satisfactorily if only one ground develops on them. The Megger readings are turned over to our maintenance force. If a reading below one megohm is obtained, immediate attempt is made to find the cause of the low reading. Readings between one megohm and 10 megohms are worked on at leisure, while readings above 10 megohms are considered satisfactory. All 4-kv. and 15-kv. cables are Meggered" once a year and the readings compared to previous ones. If any decrease in insulation resistance is noted attempts are made to find the cause.

Methods for Locating Faults

In the actual location of faults on buried cables there are four general methods in use. These are tone, bridge, "bump method" and the old tried and not so true "smellerator."

None of these are in themselves infallible in all cases. The tone may not stop at the fault, the bridge may not check, the noise of the "bump" method may be spread over quite a distance or the workman's olfactory organs may not that day be tuned to the exact odor of burned insulation. However, a combination of any two of the first three methods should locate any fault within digging accuracy. Too much importance cannot be placed upon the necessity of accurately locating a fault.

Experience has shown us how valuable it is to have the same men work as a fault-locating crew and for this crew to follow a definite routine of

*Abstract of paper, Missouri Valley Electric Association.

testing to locate the fault. While one regular crew ordinarily handles all of this work, additional crews are trained and available for use in emergencies.

On power cable little preliminary work is needed before attempting to locate a fault on a cable that has failed in service. However, on street-lighting cable, and others which have shown only low insulation resistance, the weak spots must be burned down to a fairly low resistance ground before any locating method will work. We have found that a 3-kva. transformer of 120 volts to 550–1,200–2,400–4,800–6,600 volts is satisfactory for a greater portion of this work. Load coils are used in the primary circuit to limit the current to a safe value and to permit the power to "hang on" and carbonize the faults.

Find Faulted Section

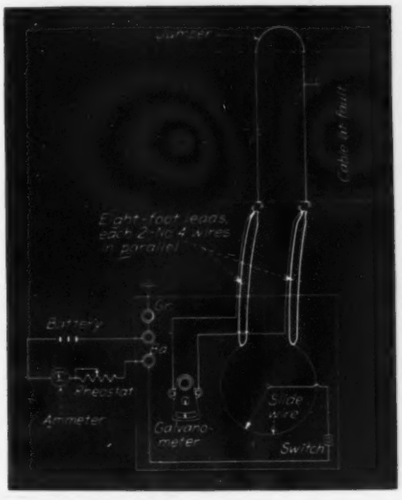
Before this "burn down" is attempted the actual section of cable in which the fault is situated must be found. This is done on street-lighting cable by "Meggering" the entire circuit, then one-half of the circuit, then one-half of the faulty half, and so on until the actual section is found. In this manner only four to six Megger readings are needed. The cutouts or potheads in the bases of the street-lighting standards are used as points of test and sectionalization. This work progresses very rapidly, only 20 or 30 minutes being required to break the circuit up in this manner and to localize the fault. If cutouts and insulating transformers are not used the connection may be broken in the lamp sockets. Our yearly tests on power circuits are made one section at a time so that this preliminary work is not needed.

After the faulty section has been located high voltage is applied and the fault burned down. At this point any of the four methods mentioned previously may be used.

The "smellerator" is probably the oldest method in use. It is evident that this method is very slow and costly. We have long since ceased to pay any attention to surface indications until after both tone and bridge have located the trouble.

The "bump" method is one developed by the Detroit Edison Company and called by it "Cable fault location through vibration caused by application of steep-fronted wave." This system is desirable in that no calculations are needed, only a good set of ears. Its disadvantage is that a source of high-voltage direct current is needed to charge the condenser and that a difference of opinion may exist as to the exact spot from which the sound emanates.

Several types of bridges may be used in the location of faulty cable. Each of these, except the capacity bridge, depends upon the faulty wire being continuous from end to end and upon a good, not faulted, wire being available along the same route. We have found that a slide wire type of bridge is most suitable for this work. This is a modified type of Murray bridge and all of the calculations required are matters of simple proportion or multiplying by a decimal (see accompanying illustration).



POWER CABLE fault bridge

For the return wire on our street-lighting single-conductor system we have reels of flexible wire calibrated in length of street-lighting cable. These are carried in lengths of 50, 100, 200 ft. and three of 300 ft. as they have been found most suitable for our use. A length of this stranded wire is measured in our laboratory and its resistance corrected to that of the solid conductor street-lighting cable. In one case a wire which is the electrical equivalent of 300 ft. of street-lighting cable is a little more than 315 ft. in physical length. One or more of these wires is used between the bridge and the far end of the faulty section. This length and the actual length of the cable as shown on our records are used for the circuit length. Two readings are taken from each end of the section, one with the bridge in its regular position, the other with the leads reversed. An average of the four readings should locate the fault. This same type of bridge using high-voltage direct current is used to locate faults without the preliminary burn-down operation. As high as 22 kv. d.c. has been used with success on 15-kv. cable.

For a number of years we have used the Lundin fault locator as a method of placing a tone on our faulty cables. This is essentially a method of applying a 60-cycle tracer current to the conductor and then varying rapidly the amount of current which passes through the fault. This seems to have characteristics superior to methods which start and stop completely this tracer current. A loop-exploring coil with head phone is used to pick up this tone. This device has given excellent results in locating trouble. The high-voltage transformer previously mentioned is used with this device, with 550 volts or 1,200 volts usually being impressed on the cable. Too much current through the fault will permit the tone to carry past the fault, while too little current will make the tone inaudible at the ground surface.

Our accepted routine is to obtain both bridge and tone locations of all faults. In this way each device checks the other and the location of the fault is much more certain. In no case of a single fault on a section of cable has this double method of location given erroneous results.

Special Truck Used

All of the test equipment used by one crew for locating any type of cable fault is carried permanently on a specially designed truck. In addition to the fault-locating equipment, sufficient material and tools are carried to do any kind of a maintenance job on cable. A 3-kva., 115-volt, 60-cycle generator is driven through the truck gear box to furnish energy for tests and for lights when needed. This generator has been one of our greatest time savers. It eliminates temporary secondary extensions with their attendant poor voltage and it permits tests on boulevards and in parks where no secondary service is available. All equipment possible is so mounted on the truck that it can be used properly without moving either it or any other piece of equipment.

Semi-Storage Air Conditioning Permits Off-Peak Operation

Meter shop and engineering department installation of Des Moines utility yields operating data as a basis for off-peak loads and off-peak rate concessions

J. M. DEAN, Des Moines Electric Light Company, Des Moines, Iowa

A SEMI-STORAGE TYPE of air conditioning was installed last June in this company's engineering and meter departments' office and meter shop. This type of system was chosen to permit a first-hand study of the economic and practical possibilities of getting air-conditioning load off the lines during peak-load periods.

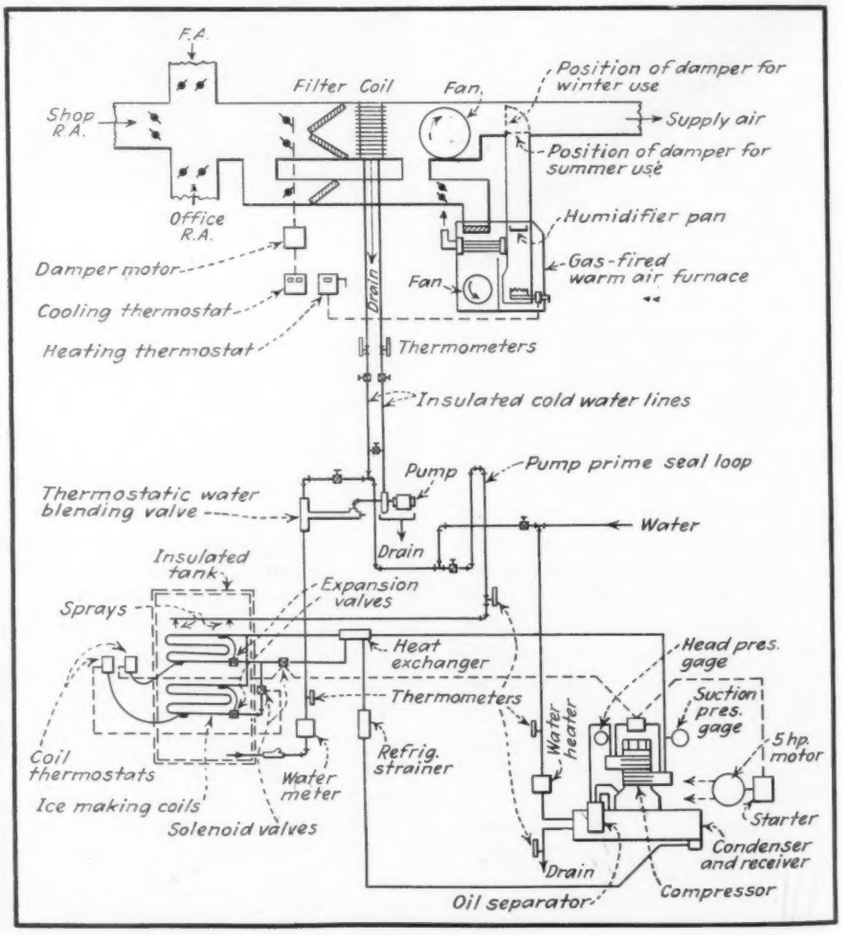
It was found that the compressor ran 62.3 per cent of the total elapsed time of the test, thus indicating that compressor operations may be discontinued during system peaks.

Some form of rate concession would probably be necessary to induce customers to purchase and use air-conditioning equipment adapted to off-peak operation. The cost of generating, distribution and major substation equipment may be around $250 per kw. of capacity. With fixed charges of 12 per cent, the "overhead" for serving conventional air-conditioning equipment on the basis of 1,000 hours operation per year is 3 cents per kilowatt-hour consumed. Except for fuel costs and some minor items a portion of this overhead can be eliminated in rates to off-peak air-conditioning customers.

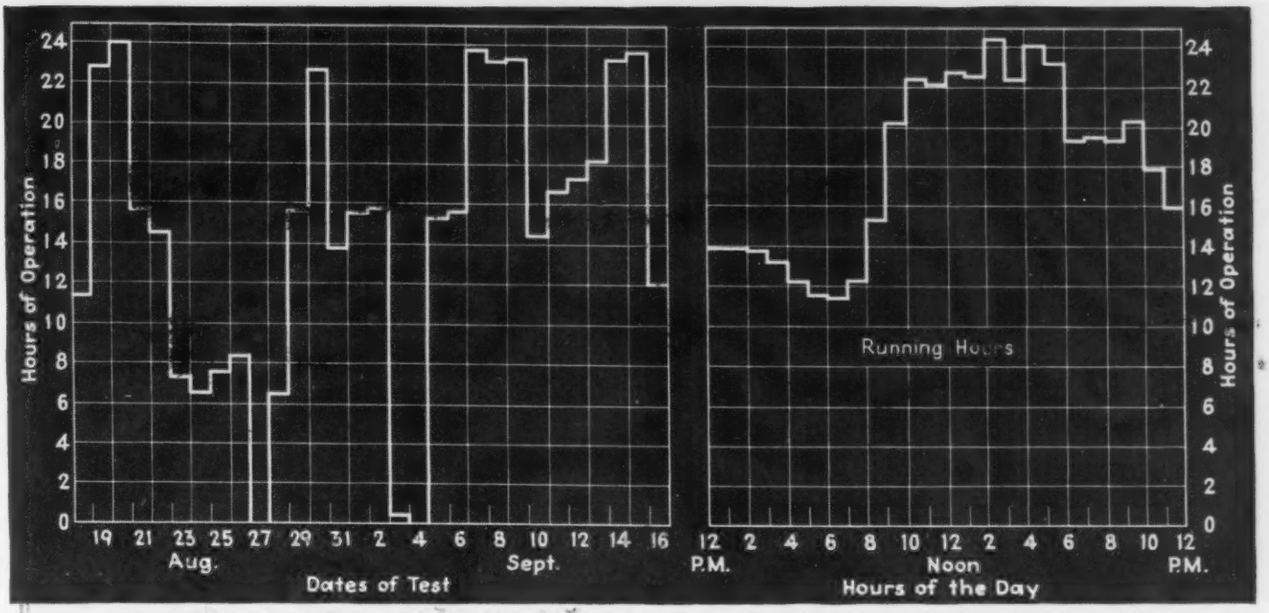
Summer Peaks

There are at present about 8,000 hp. of summer air-conditioning load connected to the company's Des Moines system, serving a population of about 150,000. For the past few years the system peak has been occurring between 9 a.m. and 11.30 a.m. on hot summer days. There is no doubt that the air-conditioning load, because of its small diversity during hot days, has been contributing heavily to this system peak.

However, because of greater first costs in many cases, greater space requirements and greater energy consumption, one means of making a storage air-conditioning system attractive to users is for the power company to furnish off-peak rate compensation toward the additional owning and operating costs. Users, in this case, are considered to be customers who operate stores, general offices or other applications requiring eight to ten hours of cooling per day and including the morning hours.



SCHEMATIC DIAGRAM of storage air-conditioning system



TOTAL running hours of compressor during test — **HOURS of each day compressor operated during test**

This exempts theaters, which usually operate afternoons and evenings, and also such special applications as churches, lodges, restaurants serving only one meal a day, etc. These latter groups can usually show economies in the use of storage equipment over conventional equipment even at existing commercial rates.

It is evident that in first cost and energy consumption a storage system can exceed a conventional system by only certain limited amounts if a power company is to be able to offer satisfactory off-peak rate compensation.

The purpose of this test installation was to determine if equipment now on the market can be made to meet satisfactorily the requirements for rate compensation which power companies can afford to offer.

Test Installation Details

The conditioned space, in this installation, consists of a general office, about 30x80 ft. on the second floor of a three-story brick and concrete building, and a shop room, about 30x25 ft., on the third floor of the building. The maximum load, as determined by survey, was calculated at 10.25 tons. This low load is due largely to the fact that the walls, ceilings and floors are well insulated.

The equipment, as indicated in the accompanying schematic installation diagram, consists of a 5-hp. Freon compressor, an ice-making storage tank, a standard "conditioning cabinet" (housing filters, air-cooling coil and fan) and such accessories as a cold-water blending valve, water pump, thermometers, water meters, etc.

A rather comprehensive test on the system was conducted from August 18 to September 16, 1939.

Daily readings of kilowatt-hours, condensing water gallons, outside weather conditions and inside conditions were taken at noon. Supplementing the kilowatt-hour meter, an Esterline chart was installed and allowed to run for the full duration of the test, and from its indications it was easy to determine the running hours of the compressor, as well as the fan and pump, although the latter were only controllable manually and entries were made on the log for each on and off operation.

The noon inside conditions were translated into "effective temperature," and it is interesting to note that the average noon ET during the test was 71.78 deg., with a minimum of 69 deg. and a maximum of 73.8 deg. Optimum inside summer ET is usually considered to be 71 deg.

Table I—Summary Data on Semi-Storage Air Conditioning, August 18–September 16

A. Kw.-hr. consumed	2,454	P. Mean effective temp. inside at noon, g.p.m.	71.78
B. Condensing water — gallons	*354,316	Q. Mean weighted values of compressor performance	
C. Total hours of test — noon 8–18 to 9–16 — 29 days	696	head pressure, lb. gauge	111
D. Compressor hours of operation.	434.61	Suction pressure, lb. gauge.	18.6
E. Per cent of total time	62.3	B.t.u./hr capacity	43,700
F. Room cooling load hours (hours of pump operation)	256.57	R. Average noon demands on compr., pump and fan motors	
G. Per cent of total time	36.85	Compr. motor, kw	5.0
H. Fan motor hours of operation.	289.95	Pump motor	0.652
I. Per cent of total time	41.6	Fan motor	0.775
J. Condensing water, B.t.u. extraction	†28,041,000	Total average demand	6.427
K. Compressor, B.t.u. extraction.	†18,983,300		
L. Circulating cold water, B.t.u. extraction	17,509,000		
M. Efficiency of tank transfer (L/K), per cent	92.2		
N. Kw.-hr. consumed per room load hour (A/F)	9.55		
O. Cond. water gal. per room load hour (B/F), g.p.h.	*1,380		

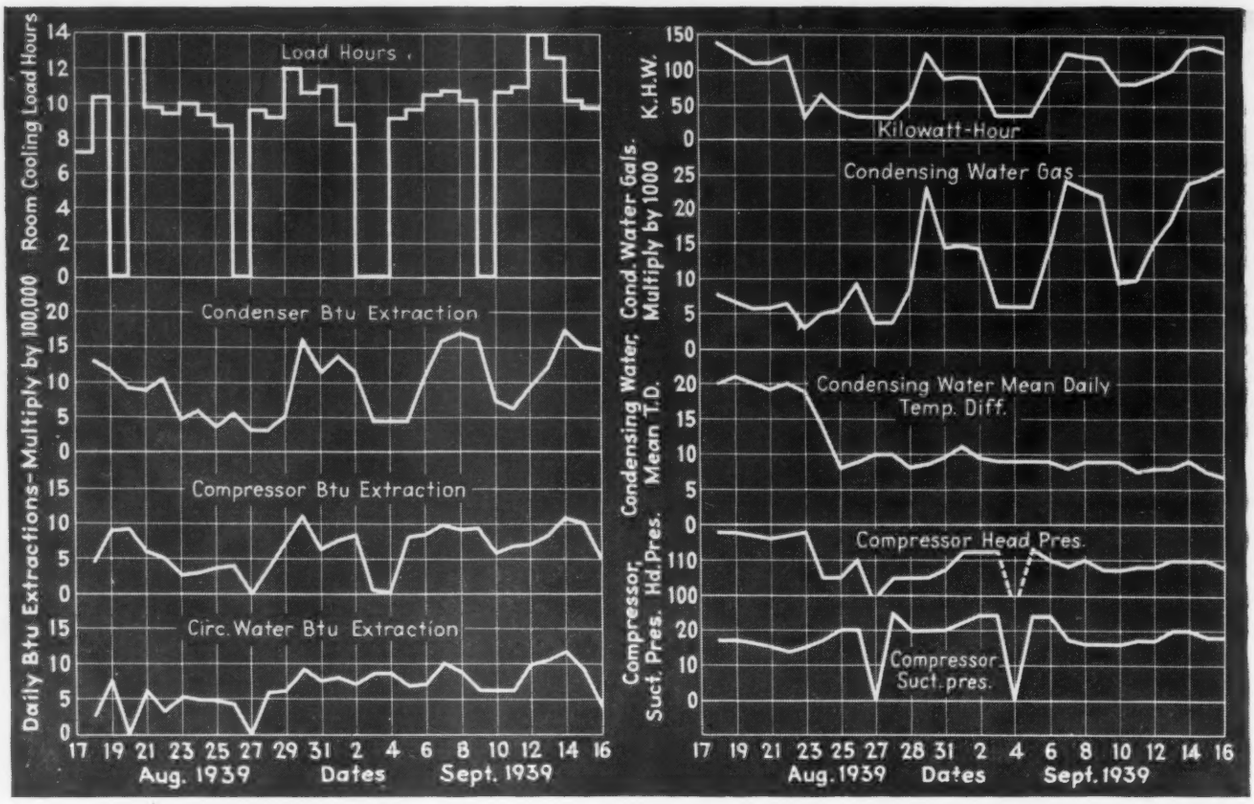
S. Load Factor $= \frac{2454 \text{ kw.-hr.}}{696 \times 6.43} = \frac{\text{Ave. Power}}{\text{Peak Power}} \ldots 0.546$

Average extraction during test period: Circ. cold water extraction, B.t.u., 17,509,000.
Room load hours, 256.57.

Ave. Extraction: 17,509,000/256.57 equals 68,300 B.t.u./hr. equals 5.7 tons/hr.

* NOTE:— The water consumption was excessive due to a faulty automatic water valve on the condensing unit. Normal consumption for this test would have been about 149,000 gal. as indicated by the manufacturers' rating table. This amounts to 580 gal. per room cooling hour.

† Approximated values as indicated by log data. Exact data not available due to night operation of compressor and lack of head and suction pressure readings during night period.


Load Hours
Room Cooling Load Hours
Condenser Btu Extraction
Compressor Btu Extraction
Circ. Water Btu Extraction
Daily Btu Extractions—Multiply by 100,000
17 19 21 23 25 27 29 31 2 4 6 8 10 12 14 16
Aug. 1939 Dates Sept. 1939
Kilowatt-Hour
K.H.W.
Condensing Water Gas
Condensing Water, Cond. Water Gals. Multiply by 1000
Condensing Water Mean Daily Temp. Diff.
Mean T.D.
Compressor Head Pres.
Compressor, Suct. Pres. Hd. Pres.
Compressor Suct. pres.
17 19 21 23 25 27 28 31 2 4 6 8 10 12 14 16
Aug. 1939 Dates Sept. 1939

DAILY B.t.u. heat extractions during test

DATA on energy use and temperature and pressure

Load hours, *i.e.*, the time during which cooling was demanded, were assumed to be equal to the hours of pump operation, so this figure was determined by taking the pump running hours off the log. The hours of fan operation were similarly taken from the log.

Compressor hours of operation, as mentioned above, were taken from the Esterline chart because the compressor could automatically come on any hour of the day or night.

Compressor Operation

Two charts are presented showing the operation of the compressor. One shows the portion of each day of the test that the machine ran and the other shows the total running hours of the test by hours of the day. It is readily seen that the compressor did not run nearly all of the time; in fact, it ran 62.3 per cent of the total elapsed time of the test. This indicates ample time for shifting the compressor off the period of system peak, although no effort was made during this test to keep the compressor off the line during the system peaks.

The installation diagram shows several thermometers on water lines and two water meters. By means of frequent readings of these and the two gauges on the compressors the following heat extractions were computed: (1) Condenser B.t.u. extraction, (2) compressor B.t.u. extraction and (3) circulating water B.t.u. extraction.

Table II—Data During Six-Day Hot Period, Sept. 5–Sept. 16

a.	Kw.-hr. consumed 6,842–5,643.	1,199
b.	Cond. water, gals. 461,450–252,520.	208,930
c.	Total hours noon 9–5 to noon 9–16 (11 days)	264
d.	Compressor hours operation	221.47
e.	Per cent of total time	81.3
f.	Room cooling load hours (hours of pump operation)	114.77
g.	Per cent of total time	43.4
h.	Condensing water, B.t.u. extraction	14,301,000
i.	Compressor, B.t.u. extraction	9,651,000
j.	Circ. cold water, B.t.u. extraction	8,848,900
k.	Efficiency of tank transfer (j/i), per cent	91.7
l.	Kw.-hr. consumed per room load hour (a/f)	10.87
m.	Cond. water gal. per room load hour (b/f), (G.P.H.)	1,820
	(G.P.M.)	30.3
Outdoor noon W.B.—	Average during this period	67.33
	Maximum	77
	Minimum	60
Indoor noon W.B.—	Average during this period	65.77
	Maximum	68
	Minimum	61
Indoor noon eff. temp.—	Average during this period	72.21
	Maximum	73.8
	Minimum	69.0

Conditions at maximum outdoor condition:
9–15–39 2 p.m. Outdoor: 97.5 D.B. 77 W.B.
Inside 77.5 D.B. 66 W.B 72.5 Eff. temp.

Two data summaries are presented, one for the full duration of the test and the other for the latter third of the test period, when the weather was considerably hotter than during the first portion of the test. On six days during the last ten days of the test period the outdoor temperature rose to over 95 deg.; on two of these six days the temperature rose past 100 deg.

After a careful study of the performance data it was found that under somewhat different conditions of head pressure and suction pressure

[*Continued on page 65*]

1940 Design Trends in Steam Capacity

A. E. KNOWLTON, Associate Editor

NEW CAPACITY is being added to utility steam plants at a rate faster than at any time during the previous decade. As a consequence, interest in watching the trends of practice is naturally great, particularly to observe the degree to which the opportunity to apply the progressive developments of recent slower years is being grasped.

What, then, are the trends as reflected in actual design commitments? Who is venturing into the highest pressures and superheats? Who is still finding opportunity and justification for superposition? Who prefer to continue on the pressure levels already well established in their plants? Which stations reflect a multiplicity of lesser advances in equipment and technique, while adhering to conventional trends in major matters? And, finally, which stations reflect unusual conditions and significant innovations and pioneering?

In the fifteen pages which follow ELECTRICAL WORLD presents in compact manner the basic design and equipment facts and objectives about 78 plants which are undergoing expansion of capacity to an aggregate of 2,592,250 kw.

Among the notable installations recorded are the forced-circulation boiler (the first by a public utility company in this country) at the Somerset station of Montaup Electric Company and the decision for 1,600-lb. operation of the 50,000-kw. superposed unit to be placed in Sherman Creek station in New York City.

The trend toward superposition continues, but it is considerably obscured in the grand total by the flood of moderate- and low-pressure condensing units now going in to meet the pressing demand for capacity everywhere. On the other hand, in the high-pressure field of 1,000 psi. and upward, the superposed and condensing units share the honors nearly equally (actually 473,750 and 547,000 kw. respectively. There is only 23,500 kw. of superposition in lower pressures. For the whole range of pressures the superposition field embraces less than one-fifth the total capacity now going in.

Pressures of 1,000 psi. or higher are reflected by 21 plants and 1,020,750 kw., which amounts to 39.5 per cent of the total. Extraction is the invariable practice in the condensing installations and was also reported for two of the superposed units in the top pressure group. It ranges from one to six points of extraction.

Coal is reported as the exclusive fuel for 43 plants in all pressure classifications. Only four stations report use of both coal and oil, but six report oil exclusively. The rest employ various combinations, including natural gas.

Pulverizing accounts for all but seven of the plants using coal. However, there are several new stoker-fired boilers, one stated to be the largest for anthracite and another the largest yet for bituminous.

Both the hydraulic (nine cases) and electromagnetic (four cases) forms of adjustable-speed couplings are represented in the fan drives, but the majority of new plant additions still hold to constant-speed motors and some form of vane or louver control of combustion air and draft. As for feed-pump drives, almost 40 per cent (31 plants) have a combination of motor and turbine, while eleven plants, mostly in the plants with pressure above 1,200 psi., use turbines exclusively for the pump drives and fifteen have adopted motor drives exclusively.

Cooling towers are provided in conjunction with eight plants totaling 141,000 kw. and spray ponds for two plants totaling 23,000 kw. Feedwater treatment, as might be expected, reflects special consideration.

Two-pole, 3,600-rpm. generators outnumber the 1,800-rpm machines in the ratio of 5 to 1, but only 1.5 to 1 in capacity because several of the larger units (one 147,000 kw.) hold to 1,800 rpm. speed. The hydrogen-cooled generators, however, outnumber the air-cooled units only 3 to 1, showing a considerable adherence to air-cooling even for high-speed units. On the question of facilities for fire extinguishing, 22 plants reported "none," fifteen have adopted carbon dioxide, eight water spray and two steam.

These are only a few of the predominances or trends which can be deduced from the comprehensive data which follow. Whether or not one wishes to analyze the information in this way, the compilation affords a condensed record about the unusually large number and diversified character of plants that mark the 1940–42 spurt in capacity.

Plants are arranged (1) in order of pressure at the turbine and (2) in order of size in kilowatts. Only plants which were first operated since January 1, 1940, or were under construction or ordered during 1940 are included.

High-Pressure Plants

(1,000 psi. and upward)

SHERMAN CREEK

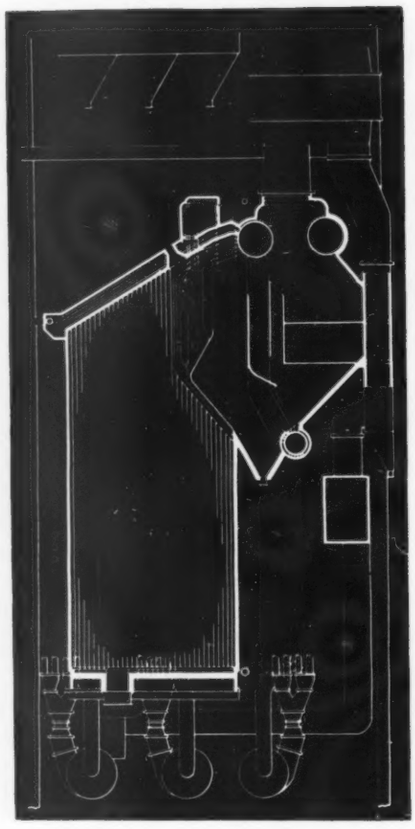
Consolidated Edison Company of New York, Inc., N. Y. City

50,000-kw., 1,600-psi. 950-F. back-pressure unit

"In planning the initial topping installation for Sherman Creek station the ultimate installation had to be considered, together with physical limitations of the site. The boiler room, which is bounded by three streets, is practically square, which dictates a symmetrical arrangement of four boilers for maximum space utilization. The amount of low-pressure capacity for ultimate consideration is 196,000 kw. This amount of capacity could not be accommodated by two topping turbines since their capacity would exceed present manufacturing limitations. As a consequence, four units were decided upon, the first of which will occupy one-fourth of the available space and will supply sufficient steam to meet one-fourth the ultimate requirements, or 49,000 kw. With this basic assumption the steam to be exhausted by the high-pressure turbine is established and its capacity depends on initial steam conditions and the cycle arrangement. The higher the initial pressure and temperature the greater the capacity of the topping unit for a given exhaust pressure.

"In choosing the initial steam conditions and cycles for study a number of interrelated factors had to be considered. The maximum safe temperature for carbon molybdenum steel established the initial temperature limit at 950 F. Preliminary studies indicated that the pressure should be made as high as was consistent with adequate steam temperature for the low-pressure turbines, with due consideration to cost of boiler and other pressure parts.

"With a fixed initial temperature to the topping unit increasing initial pressure reduces 200 lb. exhaust temperature, and vice versa. It is desired to maintain superheat about 100 F. or above in the 200-lb. steam to the low-pressure turbines, since maintenance becomes excessive due to water erosion in the lower stages when sufficient superheat is not maintained. To meet these low-pressure steam conditions without the expense of reheat 1,600 lb. is the upper limit to initial pressure with 950 F. temperature.



"With present limitations on drum welding and X-ray inspection the pressure limit for welded drums is approximately 1,700 lb., or about 1,600 lb. at the throttle, deducting superheater pressure loss. Above this pressure forged drums are required with conventional boiler design, which adds to the cost and time required for delivery.

"At Sherman Creek the top pressure for welded drums with the top temperatures for carbon molybdenum steel results in exhaust temperature from the topping turbine appropriate for the existing low-pressure units. This fact dictated studies B_1 and B_2.

"Scheme 'A' was chosen as the basis of comparison, since it represents conventional topping practice. The cost of additional capacity made available by higher initial steam conditions is shown in the accompanying table and it is evident that for this particular case Scheme 'B_1' is most attractive.

"Higher pressures with reheat were considered, one typical case of which is shown in D_1, but proved unattractive since boiler and piping costs increase substantially with increased pressure and reheat. At the time of making this study prices of reheat boiler equipment and necessary piping were such as to penalize the cycle. Since the low-pressure turbines are built for a maximum temperature of about 600 F., the economy of reheat is limited, while the major portion of the reheat investment would be required.

"The foregoing considerations combined to establish the initial steam conditions at 1,600 lb. and 950 F."

W. E. CALDWELL,
Mechanical Plant Engineer
Consolidated Edison Company of New York

Fuel—Coal (14,170 B.t.u. and 2,713 F. ash fusion) fed by chutes from raw coal bunker to individual scales, thence by feeders to three Raymond Bowl (size 613) pulverizers; twelve burners, three per corner.

Boiler—One Combustion Engineering 1,000,000-lb.-per-hour bent-tube, continuous slag tap boiler. Steam at superheater outlet, 1,625 psi., 935 F. Tentative data on boiler: heating surface, 11,410; waterwall area, 10,830; air heater surface, 285,200; economizer surface, 32,500; superheater surface, 29,300; gas by-pass superheat control.

Turbine—Westinghouse impulse-reaction 50,000 kw., 3,600 r.p.m., 1,600 psi., 950 F. for operation at 215 psi. absolute back pressure and one extraction point at 415 psi. absolute.

Generator—Westinghouse hydrogen-cooled 50,000 kw. (at 0.80 p.f.), 13.8 kv.

Other details not established.

Sherman Creek Study—Unit No. 9

Comparison of some of the schemes used in the preliminary study. Based on a constant low-pressure generation of 49,000 kw.

Scheme	A	B_1	B_2	D_1
Throttle steam, high-pressure unit:				
Pressure, lb./in.² g.	1,250	1,600	1,600	2,200
Temperature, F.	925	950	950	900
Flow, lb./hr.	765,000	839,000	885,000	888,000
Reheat temperature, F.	.....	.....	.....	900
Final feedwater temperature, F.	386	446	488	533
Station heat rate, B.t.u./net kw.-hr.	11,415	10,965	10,900	10,650
Net added capacity, kw.	37,260	43,865	44,930	48,380
Capacity gain over A, kw.	.....	6,605	7,670	11,120
Cost per added kw. over A (value of basic capacity $100/kw.)	.....	$26.80	$40.60	$108.00
Cost per added kw. over B_1	.....	.....	126.20	226.50
Cost per added kw. over B_2	.....	.....	.....	258.00

SOMERSET

Montaup Electric Company, near Fall River, Mass.

25,000-kw., 1,800-psi., 950 F. superposed

A Lamont forced-circulation boiler, the first of its kind to be installed by an American public utility company, will make the station significant. Water is drawn from the drum at each end through a 14-in. down-comer to three centrifugal type pumps which force the water through the steam-generating tubes, all of which will be located in the furnace walls. The tubes will be 1¼ in. outside diameter. Two of the pumps will be both turbine and motor driven and one only turbine driven. The pressure required to force the water through the tubes will be from 35 to 50 lb. It is expected that about 2,500,000 lb. of water will be circulated per hour or a ratio of water circulation to steam generation of 3.85 to 1.

Fuel—Pulverized coal (14,300 B.t.u.) or oil (18,000 B.t.u.) will be fired tangentially over a furnace floor of the slag bottom type. Auxiliary oil burners will be placed in the upper part of the furnace wall and be used at lower outputs to maintain superheat temperature.

Turbine—The turbine will exhaust at about 400 psi. and 625 F. through a reheater into the 375 psi. steam mains serving two 35-000-kw. condensing units in the existing station.

Feed water — Three Ingersoll-Rand 945-g.p.m. feed pumps will be driven by General Electric turbines.

Boiler—The Combustion Engineering forced-circulation, bent-tube, continuous slag drip boiler will have a capacity of 650,000 lb. per hour with 1,875 psi. and 960 F. at superheater outlet. Furnace volume, 31,200; waterwall area, 18,000; economizer surface, 24,500; superheater surface, 27,000. Damper bypass automatic control of superheat.

Fans — Two Sturtevant 110,000-cfm. forced-draft fans with motor-drive, variable-speed coupling and automatic control. Two Sturtevant 179,500-cfm. induced-draft fans similarly driven and controlled.

Turbine—General Electric 25,000-kw., 3,600-rpm. superposed, 1,800 psi., 950 F.

Generator — Hydrogen-cooled 14-kv. generator rated 20,000 kw. at 0.70 pf. and 25,000 kw. at 0.83 pf.

Scheduled operation early fall, 1941.

AVON

Pacific Gas & Electric Co., Avon, Calif.

35,000-kw., 1,400-psi., 940-F. condensing unit

Fuel—Oil, gas, pitch and sludge used for fuel; three burners per boiler. Foster-Wheeler evaporators.

Feedwater — Three (two Ingersoll-Rand, one Worthington) 1,285-g.p.m. feed pumps, each driven by dual turbine and induction motor.

Boilers — Three Babcock & Wilcox bent-tube 200,000-lb.-per-hour boilers for 1,500 psi. and 950 F. Furnace volume, 8,000; boiler heating surface, 1,553; waterwall area, 2,548; economizer surface, 5,050; superheater surface, 5,920. Bypass duct for superheat control.

Fans — One Sturtevant 67,500-cfm. forced-draft fan per boiler driven by two motors (1,200 r.p.m., 900 r.p.m.) with Bailey and vane control. One Sturtevant 134,000-cfm. boiler with similar drive and control.

Turbine—General Electric, 35,000-kw., 3,600-r.p.m. tandem-compound, automatic-extraction (240 psi. absolute) turbine, 1,400 psi., 940 F., back pressure 1.5 in. absolute.

Condenser—Worthington 18,000 sq.ft., in conjunction with cooling tower and 90-105 F. water.

Generator—General Electric hydrogen-cooled 40,000 kw. (at 0.80 p.f.), 12 kw. CO_2 fire-extinguishing system.

Scheduled operation late 1940.

MARTINEZ

35,000-kw., 1,400-psi., 940 F. condensing unit

Details are identical with Avon station as given above.

OLEUM

35,000-kw., 1,400-psi., 940 F. condensing unit

Details, except for use of San Francisco Bay cooling water, are identical with Avon and Martinez stations.

FISK (Unit No. 17)

Commonwealth Edison Company, Chicago, Ill.

147,000-kw., 1,250-psi., 925 F. condensing unit

Boilers much larger than any previously used by the company, furnace design more generous, giving lower rate of heat release. Steam temperature controlled by attemperator, expected to be superior to damper schemes previously used by Commonwealth Edison. The turbine will be one of the largest single-shaft units on the company's system.

Fuel—Coal (10,000 B.t.u., ash fusion 1,950 F.) handled by Mead-Morrison and Robins facilities; three pulverizers and twelve burners per boiler.

Feedwater—Evaporators used to treat 1,200,000 lb. per day of feedwater (solids 1 ppm.). Four Worthington 1,250-g.p.m. feed pumps, three motor-driven and one turbine-driven.

Boilers—Two Babcock & Wilcox bent-tube, slag-tap 750,000-lb.-per-hour, 1,325-psi., 935 F. Furnace volume, 46,000; boiler heating surface, 18,016; water wall area, 16,824; economizer surface, 26,700; superheater surface, 39,759.

Fans — Two Sturtevant 116,000-cfm. forced-draft fans with two-speed motors and adjustable inlet vanes. Two Sturtevant 192,500-cfm. induced-draft fans with two-speed motors and adjustable inlet vanes.

Turbine—One Allis-Chalmers 147,000-kw., 1,800-r.p.m., condensing, 1,250 psi., 925 F. with five extraction points at (full load) 480, 145, 70, 27 and 5.5 psi. absolute.

Condenser—Westinghouse 90,000-sq.ft. for 35-80 F. cooling water.

Generator — Allis-Chalmers air-cooled 147,000 kw. (at 0.85 p.f.) 12.6 kv., with CO_2 fire-extinguishing system.

Scheduled operation November, 1942.

NORTHWEST

Commonwealth Edison Company, Chicago, Ill.

50,000-kw., 1,250-psi., superposed unit

A 50,000-kw., 1,250-psi., 60-cycle unit is to be superposed on the 165,000 kw. of 230-psi. units in the station. Three high-pressure boilers will replace three old boilers, double their steam output and cut coal per unit output about one-third. Most of the steam for the station will be derived from the new high-pressure boilers, the three retained low-pressure boilers being held for emergency.

BURLINGTON

Public Service Electric & Gas Co., Burlington, N. J.

100,000-kw., 1,250-psi., 950 F. condensing unit

The new unit consists of a 100,000-kw. cross-compound condensing turbo-generator. Both elements operate at 3,600 r.p.m. The two generators are duplicates. The low-pressure element consists of two double-flow turbines coupled together.

Fuel—Coal (14,171 B.t.u.) and oil (18,434 B.t.u. per pound) are the fuels. Ash fusion at 2,400 F. Electric precipitator for fly ash, slag drip and hydrojet system under boilers. Robins conveyor belts handle river and rail coal to two pulverizers per boiler. Six coal and twelve oil burners per boiler.

Feedwater—(1 ppm. solids), treated in daily batches to drum, delivered by four Worthington pumps (each 400,000 lb. per hour). Three are electric drive and one steam.

Boilers—Two Babcock & Wilcox, 1,475-psi., 950-F. bent-tube, slag-tap boilers, each 550,000 lb. per hour. Primary and secondary furnace volume, 23,500; boiler heating surface, 7,194; waterwall area, 6,348; economizer surface, 11,500; superheater surface, 19,305, with bypass control.

Fans — One Sturtevant 160,000-cfm. forced-draft fan per boiler with single-speed motor and inlet vane dampers. One Sturtevant 275,000-cfm. induced-draft fan per boiler with two-speed motor and inlet vane dampers.

Turbine—One 3,600-r.p.m. General Electric 100,000-kw. cross-compound 1,250-psi., 950-F. condensing turbine. Back pressure is 1 in. absolute. There are five extraction points at 320, 180, 96, 28.4 and 7.5 lb. absolute.

Condenser—One Westinghouse 55,000-sq.ft., using water 35-80 F.

Generators—Two General Electric 50,000 kw. (at 0.80 p.f.) 13.8 kv., hydrogen-cooled.

Initial operation October, 1940.

MARION

Public Service Electric & Gas Co., Jersey City, N. J.

50,000-kw., 1,250-psi., 950-F. superposed unit

This new 50,000-kw. superposed unit installed to operate with existing 200-lb. turbine plant. Turbine is a duplicate of high-pressure element of Burlington cross-compound unit; generator is duplicate of the two Burlington generators. The two boilers, feed pumps and other steam-end equipment will also duplicate Burlington equipments (see above).

Fans—One American Blower 160,000 cfm. forced-draft fan per boiler, driven through hydraulic coupling by constant-speed motor. One American Blower 275,000 cfm. induced-draft fan, driven by two-speed motor, with inlet vane dampers.

Turbine—General Electric 50,000 kw., 3,600 r.p.m., operates at 205 lb. absolute back pressure with two extraction points at 452 and 291 lb. absolute.

Scheduled operation May, 1941.

WATERSIDE (Unit No. 6)

Consolidated Edison Company of New York, Inc., N. Y. City

65,000-kw., 1,250-psi., 925-F. back-pressure unit

Fuel—Gas used for starting combustion of 14,235 B.t.u. coal with ash fusion 2,573 F. Raw coal fed to each Raymond Bowl (size No. 523) pulverizer (two per boiler) directly from bunker above or by use of a run-around Redler conveyor from any other bunker. Cottrell precipitator. Eight burners per boiler.

Feedwater—Solids 15-20 ppm., treated by Permutit hydrogen and sodium Zeo-Karb. Feedwater (including make-up) amounts to 2,500,000 lb. per hour for units 6 and 7 combined. Make-up for the two amounts to 600,000 lb. per hour (half the feed-treating capacity for the whole station). Caustic addition after deaerator and high-pressure phosphate feed to drums. Three Worthington 1,500-gpm. steam-driven feed pumps.

Boilers—Two Combustion Engineering bent-tube, continuous slag tap, 615,000-lb.-per-hour continuous (maximum 680,000) capacity. Steam at superheater outlet 1,355 psi. and 925 F. Boiler heating surface, 10,815; waterwall area, 6,775; air heater surface, 54,100; economizer surface, 20,000; superheater surface, 18,850. Gas bypass superheat control.

Fans—Two Sturtevant 100,000-cfm. forced-draft fans per boiler, driven by one constant-speed (induction) motor, vane control. One Sturtevant 300,000-cfm. induced-draft fan per boiler, driven by constant-speed (induction) motor, vane control.

Turbine—Westinghouse all-reaction, 65,000 kw., 3,600 r.p.m., 1,250 psi., 925 F. with back pressure 215 psi. absolute on H.P. element and 20 psi. absolute on feed-heating element.

Generator—Westinghouse hydrogen-cooled 65,000 kw. (at 0.80 pf.) 13.8 kv.

WATERSIDE (Unit No. 7)

65,000-kw., 1,250-psi., 925 F. back-pressure unit

Points of difference from Unit No. 6 are:

Fuel—Two Babcock & Wilcox type E, size 56 pulverizers per boiler.

Feedwater—Primary feed pump (De Laval) 3,000 gpm., driven by motor with variable-speed electromagnetic coupling. Three Worthington 1,500-gpm. secondary feed pumps, two driven by constant-speed motors and one by turbine.

Boilers—Two Babcock & Wilcox bent-tube, continuous slag tap, with same ratings as above; steam at superheater outlet, 1,361 psi., 925 F. Waterwall area, 12,897; air heater surface, 74,000; economizer surface, 22,600; superheater surface, 15,220. Gas bypass superheat control.

Turbine—General Electric impulse 65,000 kw., 3,600 r.p.m., 1,250 psi., 925 F. This unit has one extraction point (on feed-heating element) at 92 psi. absolute (at full load).

Generator—General Electric hydrogen-cooled 65,000 kw. (at 0.80 pf.) 13.8 kv.

WINDSOR

West Penn Power Company, Power, W. Va.

60,000-kw., 1,250-psi., 925-F. superposed unit

Present addition by West Penn Power duplicates in capacity the 60,000-kw. addition in 1939 by Ohio Power Company in the jointly owned station. The unit exhausts at 250 psi. abs. to three existing condensing units, each 30,000 kw. Changes made point chiefly in direction of increased reliability and availability of equipment.

Fuel—Coal of 11,500-12,500 B.t.u. and 2,020 F. average ash fusion fed by belt conveyor to three pulverizers and twelve burners per boiler.

Feedwater—Westinghouse evaporators for feedwater with 10-30 ppm. of solids. Four Ingersoll-Rand pumps, each 1,165 gpm. (at 400 F.); two motor-driven and two turbine-driven.

Boilers—Two Combustion Engineering bent-tube, slag-tap boilers of 750,000-lb.-per-hour capacity for 1,350 psi., 925 F. Furnace volume, 39,000; boiler heating surface, 14,000; waterwall area, 8,971; economizer surface, 15,160; superheater surface, 21,000. Allen-Sherman-Hoff sluicing system for ash removal.

Fans—Two Sturtevant 115,000-cfm. forced-draft fans per boiler with constant-speed motor. Two Sturtevant 230,000-cfm. induced-draft fans with turbine drive.

Turbine—General Electric 60,000-kw., 3,600-r.p.m., superposed, for operation at 1,250 psi., 925 F. and back pressure of 250 lb.

Generator—General Electric 60,000-kw. (at 0.90 pf.), 11.2 kv., hydrogen cooled.

Scheduled operation February, 1942.

CHESTER

Philadelphia Electric Company, Chester, Pa.

50,000-kw., 1,250-psi., 925-F. superposed unit

80,000-kw., 280-psi., 570-F. condensing unit

Original Chester station consisted of sixteen stoker-fired boilers and four 30,000-kw. turbo-generators, two of which were later rerated to 33,000 kw.

The first of the new installations is a superposed unit served by the two new high-pressure boilers and exhausting into the 250 psi. and 600 F. prior plant. When the 80,000-kw. unit is installed it will be able to operate in parallel with the existing low-pressure machines or take the full steam output from the new superposed unit. The remaining low-pressure boilers have sufficient capacity for the existing low-pressure turbines. By expanding the station by these stages the economies of superposition are fully realized.

Fuel—Pulverized coal (14,060 B.t.u. and 2,200 F. ash fusion temperature) is fed to three pulverizers per boiler and to six burners per boiler via adaptation of existing coal-handling facilities. American Blower separator for flyash removal.

Feedwater—Solids 165 ppm., treated in 600,000-lb.-per-day quantity by Cochrane Zeolite system. Three Ingersoll-Rand 725,000-lb.-per-hour pumps driven by 2,000-hp. steam turbine.

Boilers—Two new Babcock & Wilcox bent-tube, slag-tap boilers of 600,000-lb.-per-hour rating for generation at 1,350 psi. and 935 F. Furnace volume, 27,000; combined boiler heating surface and waterwall area, 11,504; economizer surface, 17,800; superheater surface, 15,800. Automatic Leeds & Northrup damper control of superheat. United Conveyor equipment for fly ash removal; Allen-Sherman-Hoff equipment for slag removal.

Fans—Two American Blower 102,500-cfm. forced-draft fans per boiler; hydraulic coupling to 350-hp., 1,200-r.p.m. motor. Two American Blower 187,500-cfm. induced-draft fans per boiler; hydraulic coupling to 1,000-hp., 900-r.p.m. motor.

Turbine—General Electric 50-000-kw. (effective rating, 56,000 kw.), 3,600-r.p.m. superposed turbine for operation at 1,250 psi., 925 F. and a back pressure of 280 lb. without extraction.

Generator—General Electric, hydrogen-cooled, 50,000 kw. (at 0.80 p.f.), 13.8-kv. generator.

Scheduled operation **April, 1941.**

80,000-kw., 250-psi., 570-F. condensing unit

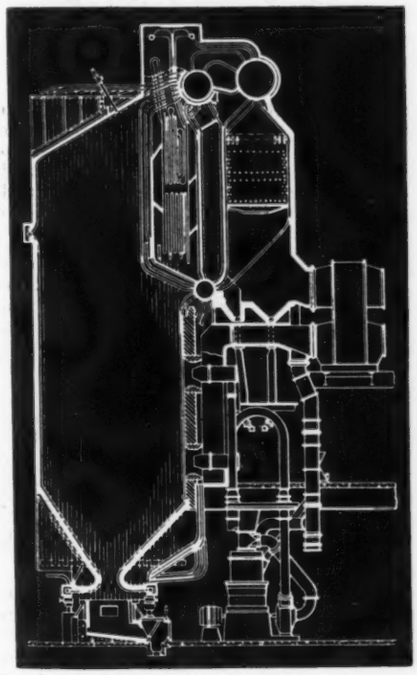
Scheduled for operation October, 1942, there has been ordered a Westinghouse 80,000-kw. (effective rating 90,000 kw.), 1,800-r.p.m. condensing turbine for operation at 250 psi., 570 F. with extraction at 66, 19.4 and 5.4 lb. absolute; generator will be a Westinghouse hydrogen-cooled unit.

WESTPORT

Consolidated Gas Electric L. & P. Co., Baltimore, Md.

25,000-kw. 1,250-lb., 900-F. superposed unit

Unit superposed on two 205-psi. condensing units operating on regenerative cycle with extraction at three points. Condensate heated to 265 F., but not deaerated in L.P. portion of cycle. Pressure of 90 psi. selected for deaeration and further heating to 330 F. to obtain highest feedwater temperature compatible with dependability, when taking into account the ability of existing L.P. feed pumps to deliver condensate to aerator and possible pressure fluctuations in 205-psi. steam system. H.P. closed heaters using 200-psi. steam to increase temperature to 383 F. could not be justified economically. Storage capacity provided for 125,000 lb. of water at 330 F.



Fuel—Coal of 14,146 B.t.u. and 2,350 F. ash fusion supplied by Robins belt conveyors to two pulverizers and four burners per boiler. Separate structure outside boiler house erected for Cottrell electrostatic precipitators, induced draft fans and stacks.

Feedwater—Deaerator (Cochrane) with addition of chemicals treats 13,680,000 lb. of feedwater per day (solids, 1 ppm.). The two Byron Jackson turbine-driven 1,260-g.p.m. feed pumps are of design widely used in the oil industry, combining the characteristics of the split volute casing and barrel types. The rotor is mounted in a lightweight split casing; entire assembly in heavy cylindrical outer casing with flanged joint at one end only.

Boilers—Two Combustion Engineering bent-tube, dry-bottom, 285,000-lb.-per-hour capacity each, 1,450 psi., 951 F. boilers. Furnace volume, 16,900; boiler heater surface, 5,315; waterwall area, 5,285; economizer surface, 9,600; superheater surface, 8,514. Bypass damper superheat control. Hydraulic sluice ash removal.

Fans—One American Blower 100,000-cfm. forced-draft fan per boiler with constant-speed motor and inlet vane control. One American Blower 195,000-cfm. induced-draft fan with adjustable-speed wound-rotor motor and damper.

Turbine—General Electric 25,000-kw., 3,600-r.p.m., superposed 1,250-psi., 900 F. and 200 lb. abs. back pressure. For bypassing, two pressure-reducing and desuperheating stations with quick-opening valves to obtain maximum flexibility of boiler operation and better control for spill-over or light load operation.

Generator—General Electric air-cooled 25,000 kw. (at 0.80 p.f.), 13.8 kv.

Initial operation August 10, 1940.

WEST READING

Metropolitan Edison Co., West Reading, Pa.

20,000-kw., 1,250-psi., 900-F. back-pressure unit

Fuel—Coal of 13,839 B.t.u. and 2,714 F. ash fusion is fed by new Webster cross conveyor (in conjunction with existing equipment) to two pulverizers and four burners per boiler for each of two new boilers. Electrical precipitation.

Feedwater—Maximum treatment is 576,000 lb. per day. Foster-Wheeler evaporators and Permutit Zeo-Karb softeners. Three Ingersoll-Rand 680-gpm. turbine-driven pumps.

Boilers—Two Combustion Engineering, 1,400 psi., 900 F. steam with 275,000-lb.-per-hour capacity. Furnace volume, 16,900; boiler heating surface, 5,570; waterwall area, 4,920; economizer surface, 8,360; superheater surface, 6,500; gas bypass damper superheat control. Dry bottom, bent tube. Hydrovac and hydro jet ash removal.

Fans—Two Sturtevant 55,000-cfm. forced-draft fans per boiler, constant-speed motor, vane control. Two Sturtevant 93,000-cfm. induced-draft fans per boiler, constant-speed motor, vane control.

Turbine—Westinghouse 20,000-kw., 3,600-r.p.m. 1,250-psi., 900-F. unit operating at 280 lb. back pressure, no extraction.

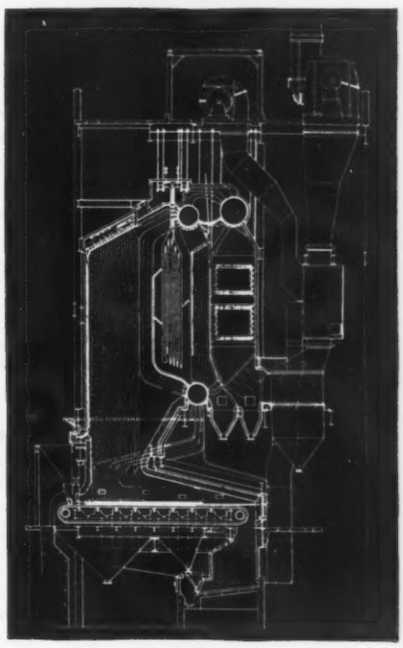
Generator—Westinghouse 20,000-kw. (0.80 p.f.), 13.2-kv. air-cooled generator with water spray nozzle fire-extinguishing system.

Scheduled operation June, 1941.

CEDAR STREET

Pennsylvania Power & Light Co., Harrisburg, Pa.

15,000-kw., 1,250-psi., 925-F. back-pressure unit



Fuel—River anthracite (10,700 B.t.u. and 2,500 F. ash fusion) to be fed by Link-Belt conveyor and bucket elevator to Coxe traveling grate stoker with 552-sq. ft. grate area. Multiclone fly ash removal; sluicing for slag and ash.

Feedwater—Zeolited evaporated make-up (Westinghouse evaporator) with 287,400 lb. treated daily. Three Byron-Jackson 225,000-lb.-per-hour pumps, two motor- and one steam-driven.

Boilers—Two Combustion Engineering bent-tube boilers each of 185,000-lb.-per-hour capacity for 1,325 psi. and 930 F.; approximate furnace volume, 8,370; boiler heating surface, 5,860; waterwall area, 1,612; economizer surface, 11,260; superheater surface, 6,750. Manual bypass damper control of superheat. Each unit will be fired by a Coxe traveling grate stoker designed to burn river anthracite or No. 4 buckwheat. These stokers, the largest of their type yet built, will each be 25½ x 23 ft. The units will have fin-tube economizers, Elesco superheaters and tubular-type air heaters. Provision is made for collecting and reburning cinders; it is estimated this will increase over-all efficiency by 7 per cent.

Fans—One motor-driven Sturtevant forced-draft fan (62,000 cfm.) with outlet louver damper. Similar induced-draft fan of 127,500 cfm.

Turbine—General Electric 15,000 kw., 3,600 r.p.m., non-condensing, 1,250 psi., 925 F. back pressure 210 lb. absolute.

Generator—General Electric air-cooled 15,000 kw. (at 0.80 p.f.), 12.5-kv. generator. Water spray for fire.

Scheduled operation May, 1941.

PORT WASHINGTON (No. 2)

Wisconsin Electric Power Co., East Port Washington, Wis.

80,000-kw., 1,230-pound, 850 F. condensing unit

Port Washington No. 2 is designed to be essentially the same as at Port Washington No. 1. The differences rest primarily in adoption of hydrogen cooling for the generator and increased heating surface in the boiler. It is expected that the efficiency of No. 2 will probably be about 4 per cent better than the notable performance of Port Washington No. 1 for the same operating conditions and loading.

Fuel—Pulverized coal of 12,900 B.t.u. with ash softening at 2,325 F. will be used; two pulverizers and 20 burners for the single boiler, supplied by belt conveyor.

Feedwater—Solids run 50 ppm. and evaporator treatment will be used. Three 500,000-lb.-per-hour Worthington feed pumps.

Boiler—Combustion Engineering, bent-tube, 690,000-lb.-per-hour, 1,390-psi., 850-F. dry bottom, sluicing conveyor. Furnace volume, 57,640; boiler heating surface, 57,000; water-wall area, 7,870; no economizer. Superheater has 1,464 sq.ft. projected radiant and 8,700 sq.ft. convection with 1,454 sq.ft. projected radiant reheater; control by burner manipulation.

Fans—Forced draft fans (2) will probably have magnetic couplings with constant-speed motor, ratings 112,500 cfm. Induced-draft fans similarly driven but 185,000 cfm. rating.

Turbine—Allis-Chalmers, 80,000 kw., 1,800 r.p.m., 1,230 psi., 850 F., 29.5 in. abs. with five extraction points at (rated load) 401, 180, 68, 20, 4 pounds abs.

Condenser—Allis-Chalmers, 52,500 sq. ft. using 35-75 F. lake water.

Generator—Generator 80,000 kw. at 0.85 p.f., 22 kv. hydrogen-cooled (Allis-Chalmers).

MANCHESTER STREET

Narragansett Electric Company, Providence, R. I.

40,000-kw., 1,215-psi., 915-F. condensing unit

In progressive conversion from a 25-cycle railway station to a 60-cycle, four principal plans of development were considered before adopting the 1,215-psi. installation (see ELECTRICAL WORLD, November 19, 1938). It represents a lower cost development than a new plant and enables base-load scheduling of the new unit for 8,000 hours per year. It is planned to produce about 300,000,000 kw.-hr. per year from this unit at an anticipated economy of 12,000 B.t.u. per kw.-hr. Manchester Street station rate has been about 22,000 and nearby South Street station's rate 18,800. It is expected that the combined operation will result in 16,100.

Fuel—Pulverized coal (14,300 B.t.u.) or oil (18,000 B.t.u.). Stephens-Adamson conveyor. Three pulverizers and six burners.

Feedwater—E. F. Walsh chemical treatment of 16,000 lb. per hour of feedwater (solids 58 ppm. in city water) preceding evaporator. Two Ingersoll-Rand 1,100-gpm. pumps, one motor-, one turbine-driven.

Boiler—One Combustion Engineering bent-tube, dry-bottom 430,000-lb.-per-hour, 1,225-psi., 915-F. Furnace volume, 21,500; boiler heating surface, 7,775; waterwall area, 7,153; economizer surface, 15,825; air heater surface, 60,980; superheater surface, 9,170. Leeds & Northrup control of combustion and superheat. United Conveyor dry-system ash removal.

Fans—Two Sturtevant 65,000-cfm. forced-draft fans with two-speed motors and vane control. Two Sturtevant 118,500-cfm. induced-draft fans with two-speed motors and vane control.

Turbine—General Electric 40,000 kw., 3,600 r.p.m., 1,215 psi., 915 F. condensing, with extraction at 211, 112, 39 and 5.6 psi. absolute; back pressure, 1.4 in. mercury.

Condenser—Ingersoll-Rand, 28,500 sq. ft., for 34-85 F. cooling water.

Generator—General Electric hydrogen-cooled, 40,000 kw. (at 0.80 p.f.), 11 kv.

COMMERCE STREET

Wisconsin Electric Power Co., Milwaukee, Wis.

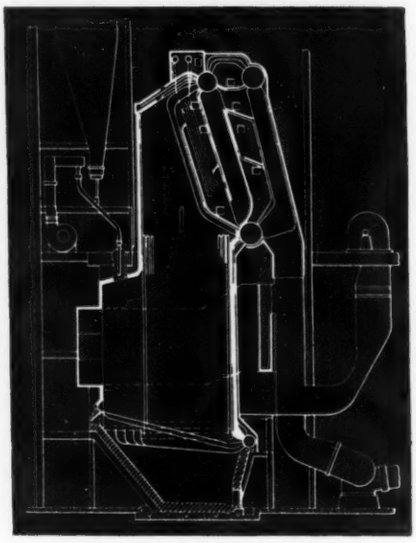
35,000-kw., 1,230-psi., 900-F. condensing unit

Fuel—Pulverized coal (12,750 B.t.u., 2,250 F. ash softening) fed to two pulverizers and twelve burners by (Chain Belt) belt elevator and conveyors. Cottrell precipitator.

Feedwater—Solids 50 ppm. International Filter H2 zeolite treatment for 6,600,000 lb. daily. Two turbine-driven Worthington feed pumps, each 400,000 lb. per hour.

Boiler—One Combustion Engineering bent-tube boiler, 1,400 psi., 900 F. of 375,000 lb. per hour, dry bottom, United Conveyor Neuveyor. Furnace volume, 30,100; boiler heating surface, 24,000; water-wall area, 6,435; no economizer. Superheater surface, 1,150 radiant (projected), and 4,250 convection; control by burner manipulation.

Fans—Two American Blower forced-draft fans (70,000 cfm.) with squirrel-cage motors and magnetic couplings. Induced-draft fans similar but 96,000 cfm.



Turbine—Allis-Chalmers condenser and turbo-generator. Turbine 35,000 kw., 3,600 r.p.m., 1,230 psi., 900 F., 28.5 in. abs. with extraction points at (rated load) 680, 305, 188, 72, 21 psi. abs.

Condenser—21,500 sq.ft., 35-75 F. river water.

Generator—35,000 kw. at 85 pf., 13.8 kv., hydrogen-cooled.

MILLERS FORD

Dayton Power & Light Co., Dayton, Ohio

30,000-kw., 1,200-psi., 900-F. superposed unit

Fuel—Coal (13,800 B.t.u. and ash fusion 2,800 F.) handled by McMyler locomotive crane, Bartlett-Snow skip hoist and Mead-Morrison bucket and hoist to three pulverizers per boiler and six burners per boiler. Cottrell precipitator.

Feedwater—Foster-Wheeler evaporator and Cochrane softener, hot process lime and soda for treatment of 300,000 lb. per day of feedwater (solids 1 ppm.). Three Allis-Chalmers 1,000-gpm. pumps driven by General Electric 1,200-psi. 900-F., 3,750-r.p.m. turbines.

Boilers—Two Babcock & Wilcox bent-tube (header-section straight), dry bottom 375,000-lb.-per-hour, 1,375-psi., 900-F. Furnace volume, 12,100; boiler heating surface, 4,817; waterwall area, 3,086; economizer surface, 17,839; superheater surface, 10,571. Vacuum fly ash and furnace ash removal.

Fans—One Buffalo Forge 128,000-cfm. forced-draft fan with automatic hydraulic coupling to motor. One American Blower 240,000-cfm. induced-draft fan with automatic-control hydraulic coupling to motor.

Turbine—General Electric 30,000-kw. 3,600-r.p.m. 1,200-psi., 900-F. superposed turbine for back pressure operation at load 230 psi.

Generator—General Electric 30,000 kw. (at 0.90 p.f.), 12-kv. hydrogen-cooled, with CO_2 fire-extinguishing system.

Both boilers are in service.

Initial operation of superposed unit October, 1940.

30,000-kw., 230-psi., 575-F. condensing unit

Order was placed in June, 1940, for a 30,000-kw. condensing unit and later for a 35-000-sq. ft. condenser for further expansion of Millers Ford capacity.

L STREET

Boston Edison Company,
South Boston, Mass.

18,750-kw., 1,200-psi., 900-F. Superposed unit

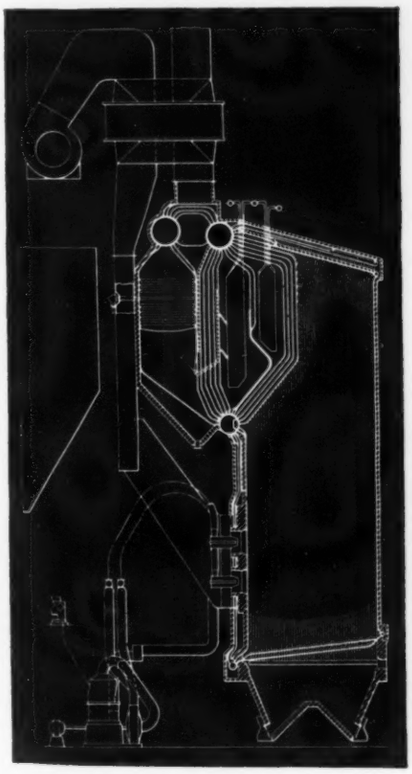
The new high-pressure boiler and high-pressure turbine will operate in parallel with two boilers and turbines installed in 1939. This additional unit will complete the "topping" of the 300-psi. turbines in this station. Exhaust steam from the two high-pressure turbines will be available to operate some of the 200-psi. turbines in this station whenever any of the 300-psi. turbines are out of service.

Fuel—Coal (14,900 B.t.u.) fed to three pulverizers and six burners per boiler; oil also used for fuel.

Feedwater—Internal treatment of condensate. One Ingersoll-Rand 800-gpm. turbine-driven feed pump.

Boiler—One Combustion Engineering 542,000-lb.-per-hour, 1,400-psi., 910 F. dry-bottom boiler; feedwater temperature 390. F.

Turbine—General Electric 18,750 kw., 3,600 r.p.m., 1,200 psi., 900 F. superposed, 325 psi. absolute back pressure.



Generator—General Electric 18,750 kw. (at 0.875 p.f.), 14.4 kv., air-cooled, with CO_2 fire extinguishing system.

40,000-kw., 1,200-psi., 950-F condensing unit

Also ordered in July, 1940 (for a location not yet established), are the following:

Boiler—One Combustion Engineering dry-bottom 430,000-lb.-per-hour, 1,350 psi., 925 F.

Turbine—One General Electric 40,000 kw., 3,600 r.p.m. 1,200 psi., 950 F. condensing with extraction at four points.

Condenser—Worthington.

Generator—General Electric 40,000 kw. (at 0.80 p.f.), 14.4 kv., hydrogen-cooled.

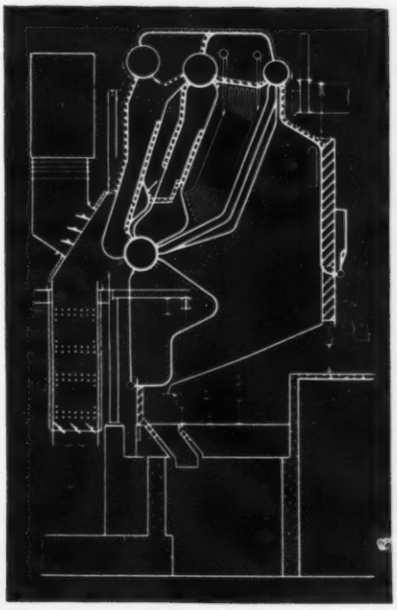
Intermediate Pressure Plants

(800 psi. to 999 psi.)

SCIOTO

Marion-Reserve Power Co.,
Marion, Ohio

14,000-kw., 925-psi., 835-F. unit



This additional installation comprises a Babcock & Wilcox 925-psi., 835-F. boiler with capacity of 150,000 lb. per hour and a 15,625-kva. generator (0.90 p.f.).

Scheduled operation April, 1941.

HARBOR

Bureau of Power & Light
Los Angeles, Wilmington, Cal.

65,000-kw., 850-psi., 900-F. condensing unit

Boiler—One Riley Stoker, 570,000-lb.-per-hour boiler (normal rating, maximum two-hour rating 675,000), 1,013 psi., 915 F., bent-tube. Furnace volume 22,500; waterwall area, 6,750; economizer surface, 10,500. Desuperheater for superheat control.

Turbine—Westinghouse, 65,000-kw., 3,600-rpm., 850-psi., 900-F. condensing unit with extraction at 299, 133, 39 and 8.94 psi. absolute.

Generator—Westinghouse, 65,000 kw. (at 0.80 p.f.), hydrogen-cooled.

WESTPORT

Consolidated Gas Electric
L. & P. Co., Baltimore, Md.

50,000-kw., 850-psi., 900-F. condensing-extraction unit

Fuel—Three pulverizers and nine burners per boiler.

Feedwater—Worthington deaerator and addition of chemicals treat 11,000,000 lb. of feedwater per day (solids 1 ppm.). Two Byron-Jackson 1,160-gpm. feed pumps (see above 25,000-kw. unit), one constant-speed motor-driven and one turbine-driven.

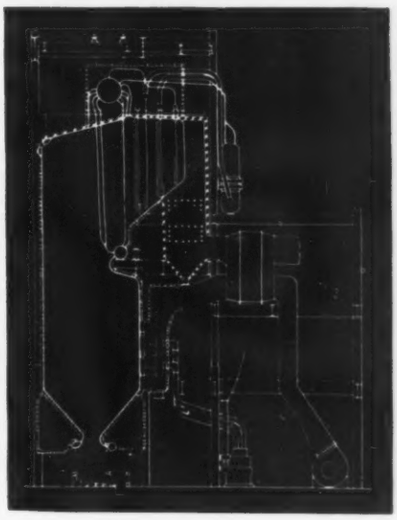
Boiler—One Babcock & Wilcox bent-tube, dry-bottom 550,000-lb.-per-hour boiler for design pressure of 1,000 psi. and 915 F. Furnace volume, 28,950; boiler heating surface, 7,364; waterwall surface, 6,202; economizer surface, 13,230; superheater surface, 21,526. Submerged desuperheater for superheat control.

Fans—Two Sturtevant 95,000-cfm. forced-draft fans driven by constant-speed motor with inlet vane control. Two Sturtevant 165,000-cfm. induced-draft fans driven by adjustable-speed, wound-rotor motor, damper control.

Turbine—General Electric, 52,000 kw., 3,600 r.p.m., condensing; 850 psi., 900 F., with extraction (at maximum load) at 366, 150, 49 and 10.7 lb. absolute.

Condenser—Worthington, 46,500 sq.ft., 38-85 F. cooling water.

Generator—General Electric, hydrogen-



cooled, 50,000 kw. (at 0.80 p.f.), 13.8 kv. Auxiliary General Electric, 2,000 kw. (0.80 p.f.), 2,400-volt, air-cooled generator.

Scheduled operation June, 1941.

Duplicates of the above 50,000-kw. condensing turbine and boiler were ordered in July, 1940, for the next addition to Westport.

VENICE No. 2

Union Electric Company of Ill., Venice, Ill.

40,000-kw., 850-psi., 900-F. condensing unit

Fuel—Coal 10,700 B.t.u., 2,100 F. ash fusion. Three pulverizers and six burners per boiler. Use car dumper, breaker and inclined conveyor for handling.

Feedwater—Spaulding type (Permutit Co.) cold lime soda and distillation for 1,200,000 lb. per day with solids 15 ppm. Worthington 1,000-gpm. feed pumps, two turbine-driven, three motor-driven.

Boilers—Two Combustion Engineering bent-tube, dry-bottom, 390,000 lb. per hour for 885 psi. operation (1,000 psi. design), 915 F. Boiler heating surface, 9,810; waterwall area, 7,495; economizer, 8,600; superheater surface, 11,690. Damper superheat control. Sluiced ash removal.

Fans—Two duplexed Green Fuel Economizer motor-driven units with hydraulic couplings. Forced-draft fans 62,500 cfm. Induced-draft fans 120,000 cfm.

Turbine—Allis-Chalmers, 40,000 kw., 3,600 rpm., 850 psi., 900 F. condensing with extraction at 201.5, 94.5, 25.0 and 5.16 psi. absolute.

Condenser—Worthington, two-pass, 37,750 sq.ft., for 32-90 F. river water.

Generator—Allis-Chalmers, 40,000 kw. (at 0.80 p.f.), 13.2 kv., air-cooled, with CO_2 fire-extinguishing system.

Scheduled operation September, 1941.

TWELFTH STREET

Virginia Electric & Power Co., Richmond Va.

40,000-kw. 850-psi., 825-F. condensing unit

Fuel—Coal of 13,997 B.t.u. and ash fusion 2,475 F. supplied to two pulverizers per boiler and eight burners per boiler. Sauerman drag scraper. Cottrell precipitator.

Feedwater—Hall Laboratories treatment of 650,000 lb. per day of feedwater (solids 3 ppm.) comprising evaporator and Hogan phosphate. Two motor-driven, direct-connected Ingersoll-Rand 840-gpm. feed pumps.

Boiler—One Combustion Engineering bent-tube, slag-tap 425,000-lb.-per-hour, 860 psi., 835 F. Furnace volume, 19,400; boiler heating surface, 24,760; waterwall area, 11,546; superheater surface, 9,282. Hydrojet sluice removal of ash.

Fans—Two Sturtevant 78,000-cfm. motor-driven forced-draft fans with Bailey air control. Two Sturtevant 155,000-cfm. induced-draft fans, same drive and control.

Turbine—General Electric, 40,000 kw., 3,600 r.p.m., 860 psi., 825 F. condensing, with back pressure 0.736 psi. and extraction at 185, 66 and 13 psi. absolute.

Condenser—Ingersoll-Rand, 27,500 sq. ft., for 32-90 F. cooling water.

Generator—General Electric, 40,000 kw. (at 0.80 p.f.), 13.2 kv., hydrogen-cooled.

Initial operation January, 1940.

REEVES AVENUE

Virginia Electric & Power Co., Norfolk, Va.

40,000-kw., 850-psi., 875-F. condensing unit

Fuel—Data same as for Twelfth Street.

Feedwater—Treatment same but for 500,000 lb. per day of water with solids 5 ppm.

Boiler—One Combustion Engineering bent-tube, slag tap, 400,000-lb.-per-hour continuous rating for 875 psi., 900 F. Damper superheat control and hydrojet sluice for ash removal. Other details, including fans, still to be settled.

Turbine—Westinghouse, 40,000 kw., 3,600 r.p.m., 850 psi., 875 F. condensing turbine with extraction at 214, 73 and 11.5 psi. absolute.

Condenser—Ingersoll-Rand, 30,000 sq. ft. for 32-90 F.

Generator—Westinghouse, hydrogen-cooled, 40,000 kw. (at 0.80 p.f.), 11.5 kv.

Scheduled operation December, 1941.

HARDING STREET

Indianapolis Power & Light Co., Indianapolis, Ind.

37,500-kw., 850-psi., 900-F. condensing unit

This new unit will operate initially on steam from existing boilers at 400 psi. and 700 F. and until new H.P. steam generator is installed. This will be ordered shortly for 850 psi. and 900 F. The governing mechanism is arranged for functioning at either pressure.

Turbine—General Electric, tandem-compound, 37,500 kw., 3,600 r.p.m., 850 psi., 900 F., condensing, with extraction at 164.3, 78.5, 28.3 and 5.33 psi. absolute.

Condenser—Westinghouse, 30,000 sq. ft., for use with 40-90 F. water and 25,000 gpm. cooling tower.

Generator—General Electric, 35,000 kw. (at 0.80 p.f.), 13.8 kv., hydrogen-cooled.

STAMFORD

Connecticut Power Co., Stamford Division, Stamford, Conn.

25,000-kw., 850-psi., 900-F. condensing unit

Present station has four 200-psi. turbo-generator units with nameplate ratings of 12,500, 7,500, 2,500 and 2,500 kw.; one 400-psi., 15,000-kw. unit to which there is being added this 850-psi., 25,000-kw. unit.

Steam header systems interconnected, with reducing valves for maximum operating flexibility; new 875-psi. boiler can thus serve low-pressure units. Station operating efficiency expected to be improved by the new increment.

Fuel—Coal (14,550 B.t.u. and ash fusion 2,400 F.) and oil (18,000 B.t.u. per pound). Two pulverizers and four burners. Robins belt conveyor. Cottrell precipitator.

Feedwater—Hall treatment. Three Ingersoll-Rand 725-gpm. feed pumps, two electric and one steam-driven.

Boilers—One Babcock & Wilcox 250,000-lb.-per-hour dry-bottom, 875 psi., 900 F. Furnace volume, 20,250; combined heating surface and waterwall area, 6,316; economizer surface, 7,500; superheater surface, 8,864. Attemperator for superheat control. Ash-pneumatic removal.

Fans—Two American Blower duplex units driven by 300-hp. motor through hydraulic coupling. Forced-draft fan, 55,000 cfm.; induced-draft fan, 83,000 cfm.

Turbine—General Electric, 25,000-kw., 3,600-rpm., 850-psi., 900-F. condensing unit with extraction at 94.5; 34.3 and 10.8 psi. absolute.

Condenser—Westinghouse, 25,000 sq. ft., for 40-85 F. harbor water.

Generator—General Electric, 25,000 kw. (at 0.80 p.f.), 13.9 kv., hydrogen-cooled.

Scheduled operation August, 1941.

CANNON STREET

New Bedford Gas & Edison Light Co., New Bedford Mass.

7,500-kw., 850-psi., 825-F. superposed unit

In this plant (110,000 kva.) the ratio of boiler capacity to turbine capacity was decidedly out of balance, the excess capacity resting with the turbines. A topping turbine was selected to expand the steam generated by two new 850-psi. boilers for use in eight turbines formerly incompletely served by the four existing 200-psi. boilers. The coal rate will probably be reduced from 1½ to 1 lb. per kw.-hr.

Fuel—Coal (14,100 B.t.u. and 2,500 F. ash fusion) and oil. Combustion Engineering Stoker.

Boilers—Two Babcock & Wilcox 150,000-lb.-per-hour bent-tube, dry-bottom, 925-psi., 825-F. Furnace volume, 8,100; boiler heating surface, 15,050; waterwall area, 2,380.

Turbine—General Electric 7,500-kw., 3,600-r.p.m., 850-psi., 825-F. superposed unit with no extraction.

Generator—General Electric 7,500 kw. (at 0.80 p.f.) 13.2 kv., air-cooled, no fire-extinguishing system.

Scheduled operation October, 1941.

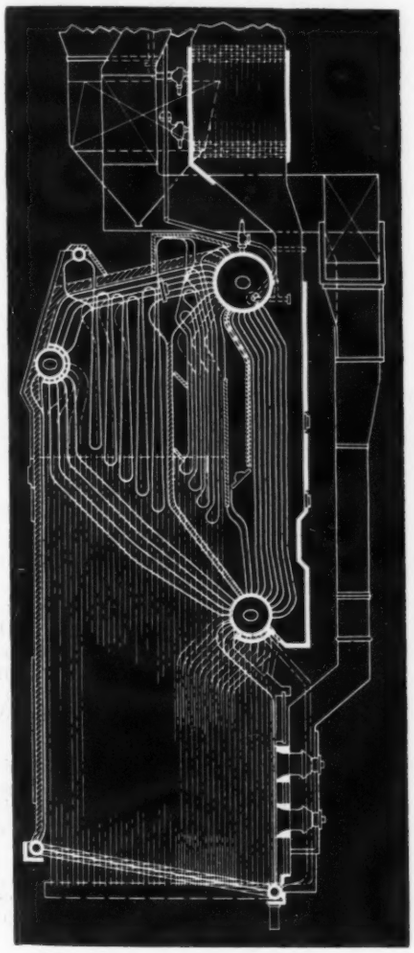
LAUDERDALE

Florida Power & Light Co.,
Dania, Fla.

25,000-kw., 850-psi., 900-F. condensing unit

Fuel—Oil of 18,300 B.t.u. per pound supplied to six burners.

Feedwater—Three Worthington pumps for 185,000-lb.-per-hour capacity each; two motor-driven, one turbine-driven.



Boiler—One Riley Stoker, bent-tube, 300,000-lb.-per-hour boiler for 1,025 psi., 908 F. operation. Furnace volume, 12,000; boiler heating surface, 10,850; waterwall area, 5,740; economizer surface, 7,000; superheater surface, 11,700. Manual bypass damper superheat control.

Fans—One Sturtevant 94,000-cfm. forced-draft fan driven by 1,160-r.p.m. motor, vane control. One Sturtevant 145,000-cfm. induced-draft fan driven by 860-r.p.m. motor, vane control.

Turbine—Westinghouse 25,000 kw., 3,600 r.p.m., condensing-extraction, for 850 psi., 900 F. operation, with extraction at 242, 143, 52.5 and 13.7 lb. absolute.

Condenser—Foster-Wheeler, 21,000 sq. ft., cooling water 70-100 F.

Generator—Westinghouse, hydrogen-cooled, 25,000 kw. (at 0.80 p.f., 31,250 kw. at 1.00 p.f.), 13.8 kv.

Scheduled operation, late 1940.

BUCK—Unit No. 3

Duke Power Company,
Near Spencer, N. C.

80,000-kw., 825-psi., 900-F. condensing unit

Boilers, furnaces, pulverizing and burning equipment and fans are duplicates of earlier units.

Fuel—Coal runs 12,500-14,500 B.t.u., ash fusion 2,100-2,800 F.; three puverizers per boiler, twelve burners per boiler (three per corner); Hydrovac fly ash removal and Hydro-ash sluicing. Drag scraper, belt conveyors and flight conveyors.

Feedwater—Make up feedwater 3 ppm.; condensate 1 ppm.; evaporator for makeup. Three 850-gpm. motor-driven pumps and one turbine-driven.

Boilers—Two 900-psi., 900-F., 375,000-lb.-per-hour (400,000 maximum) bent-tube, dry-bottom boilers. Furnace volume, 19,300; boiler heating surface, 18,200; waterwall area, 6,061; superheater surface, 9,600; superheat control by motor-operated by-pass dampers.

Fans—One 117,000-cfm. forced-draft fan per boiler driven by constant-speed motor through hydraulic coupling with remote control. One 215,000-cfm. induced-draft fan per boiler similarly driven and controlled.

Turbine—One 80,000-kw., 1,800-r.p.m., 825-psi., 900-F. condensing turbine (1 lb. absolute exhaust) with five extraction points 263, 129, 73.5, 43.8 and 5.6 lb. absolute.

Condenser—Surface 60,000 sq.ft.; cooling water range 35-85 F. from Yadkin River.

Generator—Hydrogen-cooled 60,000 kw., 13.2 kv.

Scheduled operation July, 1941.

CLIFFSIDE

Duke Power Company,
near Cliffside, N. C.

Two 40,000-kw., 825-psi., 900-F. condensing unit

Fuel—12,500-14,500 B.t.u. coal with ash fusion 2,100-2,800 F. Drag scraper and belt and flight conveyors; three pulverizers per boiler, twelve burners per boiler (three per corner).

Feedwater—Evaporators for make-up (3 ppm.); four 850-gpm. pumps, of which three are motor-driven and one turbine-driven.

Boilers—Two new 900-psi., 900-F. boilers with same data as for Buck station (Unit No. 3) above. Also same data for fans.

Turbines—Each of two turbines is 40,000 kw., 3,600 r.p.m., 825 psi., 900 F. with four extraction points at 212, 83, 30.6 and 5.78 lb. absolute.

Condenser—33,000 sq.ft., uses Broad River water, 35-85 F.

Generators—Each of two new generators 40,000 kw. at 0.80 p.f., 13.2 kv., hydrogen-cooled.

Initial operation July, 1940.

ACME

Toledo Edison Company,
Toledo, Ohio

50,000-kw., 820-psi., 825-F. condensing unit

Fuel—Coal, 12,600 B.t.u. Ash fusion, 2,000-2,850 F.; three pulverizers per boiler, six burners per boiler.

Feedwater—Three Worthington 680-g.p.m. turbine-driven pumps.

Boilers—Two Babcock & Wilcox, 350,000-lb.-per-hour, 900 psi., 825 F., bent-tube, slag-drip boilers. Boiler heating surface, 16,520 each, no economizer, no superheat control.

Fans—One Sturtevant 96,000-cfm. forced-draft fan per boiler with constant-speed motor and vane control. One Sturtevant 218,000-cfm. induced-draft fan per boiler with constant-speed motor and vane control.

Turbine—Westinghouse 50,000 kw., 3,600 r.p.m., 820 psi., 825 F. condensing, with extraction at 287, 134, 45, 11, 4 and 2 psi. absolute.

Condenser—Allis-Chalmers 41,000 sq. ft., for 35-85 F. river water.

Generator—Westinghouse 50,000 kw. (at 0.80 p.f.), 13.8 kv., hydrogen-cooled.

DELRAY

Detroit Edison Company,
Detroit, Mich.

75,000-kw., 815-psi., 900-F. condensing unit

Fuel—Coal (13,580 B.t.u. and ash fusion above 2,500 F.) and gas (94.6 B.t.u. per cu.ft.). R. H. Beaumont drag-line scraper.

Feedwater—Intermittent treatment, solids 2 to 5 ppm. Three DeLaval 1,455-gpm. feed pumps; two motor-driven, one turbine-driven.

Boiler—Three Babcock & Wilcox 344,000-lb.-per-hour, 865 psi., 910 F., bent-tube. Taylor underfeed stoker, 611 sq.ft. projected area. Boiler heating surface, 7,035; waterwall area, 4,622; economizer surface, 17,760; superheater surface, 11,725.

Fans—Two Buffalo Forge 53,300-cfm. induced-draft fans. One Buffalo Forge 189,000-cfm. induced-draft fan. All three driven by direct-connected d.c. motors with hand control from boiler room.

Turbine—One General Electric 75,000-kw., 1,800-rpm., 815-psi., 900-F. condensing unit with extraction at 211, 96.4, 34 and 7.14 psi. absolute.

Condenser—Worthington, 53,620 sq.ft., for river water 32-80 F.

Generator—One General Electric, 75,000 kw. (at 0.70 p.f.), 14.4 kv., air-cooled. Steam fire-extinguishing system.

B. E. MORROW

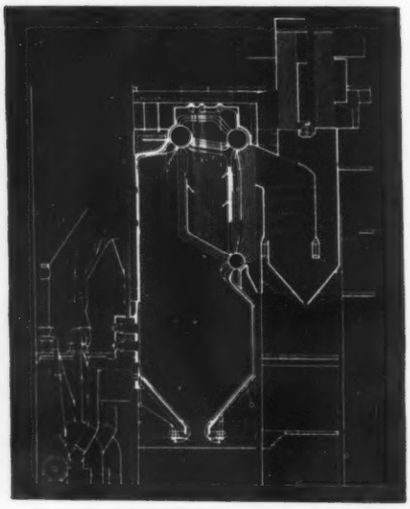
Consumers Power Company,
Comstock, Mich.

50,000-kw., 800-psi., 875-F. condensing unit

Fuel—Coal (13,300 B.t.u., ash fusion 2,300 F.), two pulverizers and eight burners. Bartlett Snow conveying belt.

Feedwater — One Worthington 1,000-gpm. motor-driven pump.

Boiler—One Foster Wheeler, 550,000-lb.-per-hour, 870 psi., 900 F., bent-tube, dry-bottom. Boiler heating surface, 10,-100; waterwall area, 5,089; economizer surface, 41,400; superheater surface, 15,-300. Damper control of superheat.



Fans—One American Blower, 90,000 cfm., forced-draft, motor-driven, vane control. One American Blower induced-draft, 300,000 cfm., motor-driven, vane control.

Turbine—General Electric, 50,000 kw., 3,600 r.p.m., 800 psi., 875 F. with extraction at 225, 124, 64.9, 23.6 and 5.95 psi. absolute.

Condenser—Foster-Wheeler, 43,000 sq. ft.

Generator—General Electric 50,000 kw. (at 0.80 p.f.), 14.4 kv., hydrogen-cooled.

Scheduled operation August, 1941.

MACON

Georgia Power Company,
Macon, Ga.

40,000-kw., 800-psi., 850-F. condensing unit

Fuel—Coal (12,650 B.t.u. and 2,200-2,700 F. ash fusion) and gas. Three pulverizers and twelve burners per boiler.

Feedwater—Two De Laval 970-gpm. motor-driven pumps.

Boiler—One Combustion Engineering 400,000-lb.-per-hour, bent-tube, dry-bottom, 850 psi., 860 F. Boiler heating surface, 18,000; water wall area, 6,221; superheater surface, 9,980. Ash sluicing system.

Fans—One Buffalo Forge 140,000-cfm., motor-driven, with vane control. One Buffalo Forge 250,000-cfm., motor-driven, with vane control.

Turbine — Westinghouse, 40,000 kw., 3,600 r.p.m., 800 psi., 850 F. condensing unit with extraction at 316, 181, 92, 30.7 and 9.2 psi. absolute (at 125 per cent load).

Condenser—Elliott, 31,300 sq.ft.

Generator—Westinghouse, 40,000 kw. (at 91.5 p.f.), 13.8 kv., hydrogen-cooled.

Scheduled operation May, 1941.

CHICKASAW

Alabama Power Company,
Chickasaw, Ala.

40,000-kw., 800-psi., 850-F. condensing unit

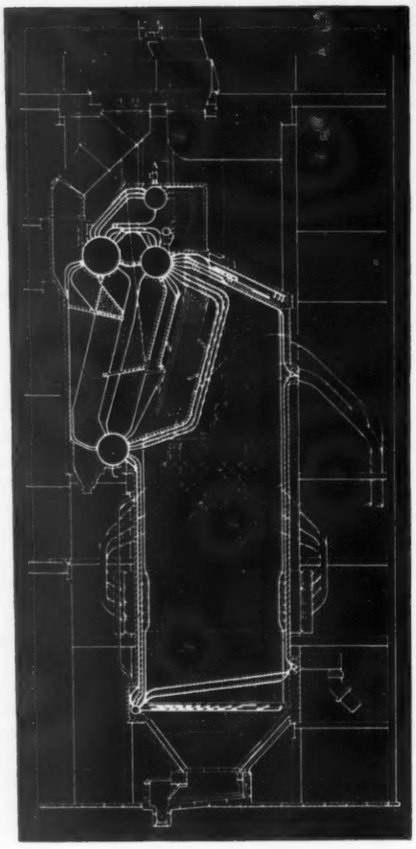
Fuel — Coal (13,113 B.t.u. and ash fusion 2,100-2,800 F.); three pulverizers and twelve burners per boiler.

Feedwater—Two Ingersoll-Rand 970-gpm. motor-driven pumps.

Boiler—One Combustion Engineering, bent-tube, dry-bottom, 400,000-lb.-per-hour, 850-psi., 860-F. Boiler heating surface, 18,000; waterwall area, 6,221; superheater surface, 9,980; damper control. Ash sluicing system.

Fans—One Buffalo Forge, 140,000 cfm., forced-draft, motor-driven, vane control. One Buffalo Forge 250,000 cfm., induced-draft, motor-driven, vane control.

Turbine—Westinghouse 40,000-kw., 3,-



600-rpm., 800-psi., 850-F. condensing unit with extraction at 249, 142, 73, 24.5 and 7.5 psi. absolute.

Condenser—C. H. Wheeler Mfg. Co. 26,800-sq.ft. unit.

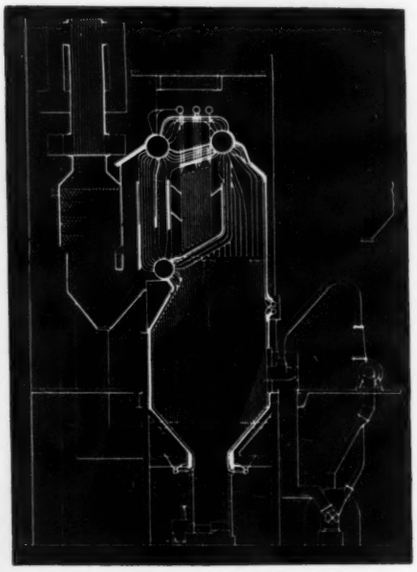
Generator—Westinghouse, 40,000 kw. (at 91.5 p.f.), 13.8-kv., hydrogen-cooled unit.

Scheduled operation June, 1941.

J. C. WEADOCK (Unit No. 2)

Consumers Power Company,
Bay City, Mich.

35,000-kw., 800-psi., 850-F. condensing unit



Fuel—Coal, two pulverizers, four burners, Robin's conveying belt.

Feedwater—One Worthington 1,000-gpm., motor-driven pump.

Boiler—One Foster-Wheeler, 400,000-lb.-per-hour bent-tube, dry-bottom, with ash sluicing system. Furnace volume, 22,000; boiler heating surface, 7,448; waterwall area, 4,076; economizer surface, 28,512; superheater surface, 9,450. Damper control of superheat.

Fans—Clarage 130,000 cfm., forced-draft, motor-driven, with hydraulic coupling. Clarage 215,000 cfm., induced-draft, motor-driven, with hydraulic coupling.

Turbine—General Electric, 35,000-kw., 3,600-rpm., 800-psi., 850-F. condensing unit with extraction at 246.5, 147, 59, 23.6 and 6.15 psi. absolute.

Condenser—Foster-Wheeler, 33,000 sq. ft.

Generator—General Electric, 35,000 kw. (at 0.80 p.f.), 14.4 kv., hydrogen-cooled.

Scheduled operation June, 1941.

TORONTO

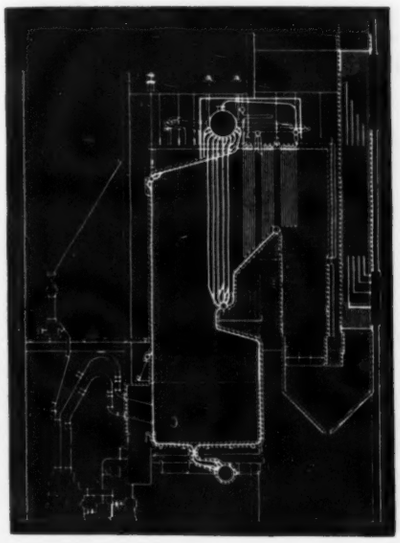
Ohio Edison Company,
Toronto, Ohio

35,000-kw., 800-psi., 850-F. condensing unit

Fuel—Coal of 12,500 B.t.u. and 2,200-2,600 F. ash fusion, three pulverizers, six burners.

Feedwater—Two Worthington 1,000-gpm., motor-driven pumps.

Boiler—One Babcock & Wilcox 400,-000-lb.-per-hour, 810 psi., 900 F. bent-tube, slag-tap. Boiler heating surface,



3,500; waterwall area, 5,477; economizer surface, 15,900; superheater surface, 11,060. Damper superheat control. Water spray ash removal.

Fans—One Sturtevant 130,000 cfm., forced-draft, motor-driven, vane control. One Sturtevant 220,000 cfm., motor-driven, induced-draft, vane control.

Turbine—Westinghouse, 35,000 kw., 3,600 r.p.m., 800 psi., 850 F., condensing with extraction at 235, 137, 66, 23.5 and 6.9 psi. absolute (full load).

Condenser—Westinghouse, 33,200 sq.ft.

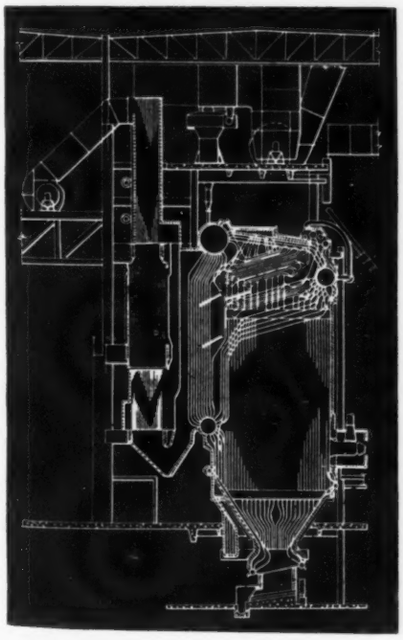
Generator—Westinghouse, 35,000 kw. (at 0.80 p.f.), 11.5 kw., hydrogen-cooled.

Unit on test run in October, 1940.

EAST PEORIA

Central Illinois Light Co.,
East Peoria, Ill.

35,000-kw., 800-psi., 850-F. condensing unit



Fuel—Coal (9,800 B.t.u.), two pulverizers, four burners, Robins conveying belt, dry removal of ash.

Feedwater—One Allis-Chalmers, 1,000-gpm., motor-driven pump.

Boiler—One Riley Stoker boiler, 375,000-lb.-per-hour, 900 psi., 900 F., bent-tube. Furnace volume, 23,500; boiler heating surface, 23,250; waterwall area, 11,500; economizer surface, 11,500.

Fans—Sturtevant, 125,000 cfm., forced-draft, motor-driven, vane control. Sturtevant, 205,000 cfm., induced-draft, motor-driven, vane control.

Turbine—Westinghouse, 35,000 kw., 3,600 rpm., 800 psi., 850 F., condensing, with extraction at 235, 137, 66, 23.5 and 6.9 psi. absolute.

Condenser—Westinghouse, 30,200 sq.ft.

Generator—Westinghouse, 35,000 kw. (at 0.80 p.f.), 14.4 kw., hydrogen-cooled.

Scheduled operation June, 1941.

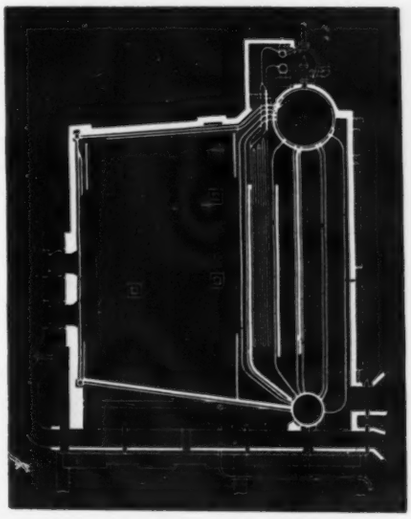
Medium-Pressure Plants

(600 psi. to 799 psi.)

GLENDALE

Glendale Public Service Dept.,
Glendale, Cal.

25,000-kw., 750-psi., 825-F. condensing unit



Fuel—Oil (18,500 B.t.u. per pound) and gas (1,100 B.t.u. per cu.ft.) are fed to four burners per boiler.

Feedwater—Griscom Russell evaporator and Zeolite treatment of feedwater. Two Pacific 500-gpm. pumps driven by two-pole motor.

Boilers—Two Combustion Engineering dry-bottom, bent-tube boilers of 200,000 lb. per hour capacity for 750-psi., 825-F. operation. Furnace volume, 7,750; boiler heating surface, 12,430; waterwall area, 2,588; superheater surface, 2,460. L. & N. damper control for superheat.

Fans—One Sturtevant 73,500-cfm. forced draft fan per boiler with two constant-speed motors and inlet louver control. One Sturtevant 126,500-cfm. induced-draft fan per boiler, similar drive and control.

Turbine—General Electric, 25,000 kw. (max.), 3,600 rpm. condensing, 600-700 psi., 825 F., with extraction at 442, 201, 78 and 22 lb. absolute (full load). Cooling tower used with Ingersoll-Rand 16,000-sq.ft. condenser (water 80-95.3 F.).

Generator—General Electric, 25,000 kw. (at 1.00 p.f.), 13.8 kv., hydrogen-cooled.

Scheduled operation January, 1941.

WAIAU

Hawaiian Electric Co.,
Waiau, Oahu, T. H.

15,000-kw., 750-psi., 825-F. condensing unit

Fuel—Fuel oil of 18,500 B.t.u. per pound pumped to burners at 300 lb. by rotary screw pump. At burners small centrifugal booster pump raises burner tip pressure to 400 lb. Peabody wide-range mechanical oil burners. Return oil handled by the booster pump.

Feedwater—Permutit Zeolite treatment applied to 25,000 lb. per day of feedwater with boiler concentration of 240 ppm. solids. Three Hydropress Byron-Jackson 16-stage feed pumps of 200 gpm. rating each, driven by 150-hp. motors (2,300 volts, 3,600 rpm.), supply 400 gpm. for full load operation.

Boiler—One new Babcock & Wilcox bent-tube integral furnace boiler of 190,000-lb.-per-hour rating for operation at 650 psi. and 825 F. Furnace volume, 7,267; combined heating, waterwall and superheater, 16,155. Smoot damper control of superheat.

Fans—One Sturtevant duplex forced-draft (47,000 cfm.) and induced-draft (85,000 cfm.) fan driven by two-speed motor with Smoot vane control.

Turbine—Westinghouse, 15,000 kw., 3,600 rpm., 650 psi., 825 F. with extraction at 147, 71, 27.5 and 8.4 lb. absolute.

Condenser—Westinghouse 14,000-sq.ft. surface condenser; water 72-74 F. from surface sources and artesian wells.

Generator—Air-cooled, 15,000 kw. (at 0.80 p.f.), 11 kv.

Initial operation August, 1940.

HOUSATONIC

Derby Gas & Electric Company,
Derby, Conn.

3,500-kw., 665-psi., 750-F. back-pressure unit

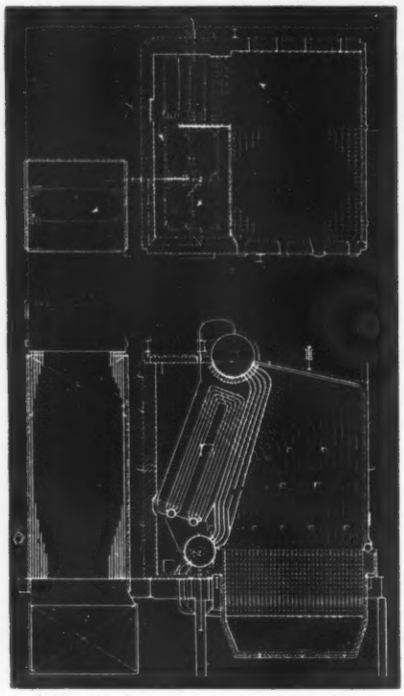
This installation duplicates a previous turbine and boiler.

Fuel—Oil of 155,000 B.t.u. per gallon.

Feedwater—Solids 10 ppm. treated (850,000 lb. per day) with trisodium phosphate. One Ingersoll-Rand motor-driven pump, 350 gpm.

Boiler—One Babcock & Wilcox bent-tube, dry-bottom boiler, 725 psi., 750 F., 125,000 lb. per hour. Boiler heating surface, 11,480; waterwall area, 1,860; air heater, 10,320; economizer none, vacuum ash removal.

Fans—One American Blower forced-draft fan, 45,200 cfm., turbine-driven, speed control. One American Blower induced-draft fan, 78,500 cfm., turbine-driven.



Turbine—General Electric, 3,500 kw., 3,600 rpm., 665 psi., 750 F., back pressure 180 lb. absolute.

Generator—General Electric, 3,500 kw. at 0.80 p.f., 7.2 kv., air-cooled.

Initial operation September, 1940.

ROCHESTER (No. 3)

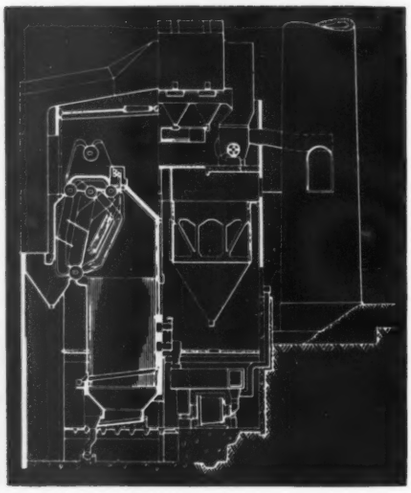
Rochester Gas & Electric Corp.

15,000-kw., 660-psi., 760-F. condensing unit

This unit is practically a duplicate of the original installation made in 1935 with the objective of simplicity in operation and maintenance. For 1939 the input per kilowatt-hour was about 15,500; a bettering is looked for in 1941.

Fuel—Coal of 13,600 B.t.u. and ash fusion 2,300 F. is fed to two pulverizers and four burners per boiler. Foster-Wheeler coal-handling facilities employed. The (fourth) Cottrell precipitator deals with fly ash; hydraulic means for furnace ash.

Feedwater—Variable feedwater solids are handled (12,000,000 lb. per day) by Cochrane special treatment using hot lime soda and acid. Two Allis-Chalmers 300,000-lb.-per-hour pumps per boiler (actually two for four boilers) are divided between steam and motor drive.



Fans—Bailey Meter control is provided for one Claridge 77,500-cfm. motor-driven, forced-draft fan per boiler and also for one Sturtevant 140,000-cfm. induced-draft fan.

Boiler—Combustion Engineering 700-psi., 780-F., 250,000-lb.-per-hour boilers put in operation in September, 1940. Furnace volume, 13,720; boiler heating surface, 15,300; waterwall area, 3,990; superheater surface, 4,450; economizer, 20,808.

Turbine—General Electric 15,000-kw., 3,600-rpm. condensing unit, 660 psi., 760 F., with one extraction point at 8 lb. absolute.

Condenser—Allis-Chalmers, 10,600 sq. ft., 33-75 F. water.

Generators—General Electric 15,000-kw. (0.80 p.f.), 11 kv., air-cooled generator with CO_2 fire protection.

Scheduled operation July, 1941.

DRESSER

Dresser Power Corporation, Terre Haute, Ind.

50,000-kw., 650-psi., 900-F. condensing unit

Fuel—Coal of 10,600 B.t.u. and 2,000 F. ash fusion temperature fed by conveyor to two pulverizers per boiler and eight burners per boiler.

Feedwater—International Filter clarifier and filter bed for feedwater. Two Worthington 761-gpm. motor-driven feed pumps.

Boilers—Two Combustion Engineering, bent-tube, slag-tap, 250,000-lb.-per-hour, 650 psi., 900 F. Furnace volume, 13,500; boiler heating surface, 6,565; waterwall area, 4,425; economizer surface, 3,780; superheater surface, 9,000; damper control of superheat.

Fans—One Sturtevant 85,000-cfm. motor-driven, forced-draft fan per boiler with damper controlled electrically. One Sturtevant 148,000-cfm. motor-driven, induced-draft fan.

Turbine—General Electric, 50,000 kw., 1,800 rpm., 650 psi., 900 F. condensing, with extraction at 200, 103, 38 and 7.4 psi., absolute.

Condenser—Worthington, 40,000 sq.ft.

Generator—General Electric, 50,000 kw. (at 0.85 p.f.), 138 kv., air-cooled.

Scheduled operation March, 1941.

BUZZARD POINT

Potomac Electric Power Co., Washington, D. C.

50,000-kw., 650-psi., 900-F. condensing unit

Features of the addition are control of condensate flow to first of four-stage contact extraction heaters, reduced noise of booster pump, automatic sequence control of turbine oil pumps, third section on Cottrell precipitator for 95 per cent elimination, and justification of rotary car dumper (see ELECTRICAL WORLD, December 14, 1940.

Fuel—Coal of 14,381 B.t.u. and 2,295 F. ash fusion temperature supplied by rotary arc dumper and belt conveyors (Link-Belt and Robins) to three pulverizers and twelve burners. Cottrell precipitator and continuous slag-tap elimination.

Feedwater—Solids 0.1 ppm., no treatment, evaporator used for make-up. Three Ingersoll-Rand 1,278-gpm. pumps; two driven by 800-hp. induction motors, one by 900-hp. steam turbine.

Boiler—One Combustion Engineering bent-tube boiler, 675 psi., 900 F., 525,000 lb. per hour. Furnace volume, 29,500; boiler heating surface, 17,150; waterwall area, 6,560; economizer surface, 13,780; superheater surface, 6,360. Automatic thermostatic and manual damper control on flue-gas by-pass for superheat control.

Fans—Two American Blower forced-draft fans of 78,750 cfm. each, with 160-hp. cage induction motor and vane control. Two American Blower induced-draft fans of 152,000 cfm. each with hydraulic coupling to 500-hp. cage induction motor.

Turbine—General Electric, 50,000 kw., 1,800 rpm., 650 psi., 900 F., 0.25 to 1.10 lb. absolute exhaust with four extraction points at 196.8, 101.4, 37.7 and 7.21 lb. absolute (full load).

Condenser—Worthington, 41,000 sq.ft., for application of river water 38-90 F.

Generator—General Electric, 50,000 kw. at 0.85 p.f., 13.8 kv., with air cooling and Lux extinguishing system.

Scheduled operation October, 1940.

EDGEWATER

Wisconsin Power & Light Co., Sheboygan, Wis.

37,500-kw., 650-psi., 800-F. condensing unit

Fuel—Coal of 13,210 B.t.u. and 2,200 F. ash temperature supplied by Link-Belt conveyor supplied to two pulverizers and four burners in existing boiler.

Feedwater—Ingersoll-Rand 800-gpm. pump, driven by constant-speed motor through hydraulic coupling.

Turbine—Allis-Chalmers, 37,500 kw., 3,600 rpm., condensing, 650 psi., 800 F., 1 in. Hg abs., with four extraction points at 206, 88, 25.1 and 6 lb. absolute.

Condenser—Allis-Chalmers, 24,000 sq. ft., using 33.70 F. water.

Generator—Allis-Chalmers, hydrogen-cooled, 30,000 kw. (at 0.80 p.f.), 12.5 kv.

Scheduled operation June, 1941.

HUTSONVILLE

Central Illinois Pub. Serv. Co., Hutsonville, Ill.

25,000-kw., 650-psi., 825-F. condensing unit

Fuel—Coal of 11,000 B.t.u. and 2,100 F. ash fusion fed by belt conveyor to two pulverizers per boiler and four burners per boiler.

Feedwater—Evaporators; two (motor and turbine drive) 715-gpm. feed pumps.

Boilers—Two 150,000-lb.-per-hour, 665 psi., 835 F., bent-tube, dry-bottom. Furnace volume, 8,830; boiler heating surface, 14,780; waterwall area, 3,026; air heater surface, 28,800; superheater surface, 4,370. Manual superheat control.

Fans—One motor-driven 51,000-cfm. forced-draft fan per boiler, vane control. One 80,000-cfm. induced-draft fan.

Turbine—25,000 kw., 3,600 rpm., 650 psi., 825 F. condensing with four-point extraction.

Condenser—28,000 sq.ft. 32-85 F. water.

Generator—Air-cooled, 25,000 kw. (at 0.80 p.f.), 13.5 kv.

Scheduled operation June, 1941.

ALEXANDRIA

Virginia Public Service Gen'g Co., Alexandria, Va.

15,000-kw., 650-lb., 825-F. condensing unit

Fuel—Plant uses 14,547 B.t.u. coal with ash fusion 2,358 F. on Westinghouse stoker with 202.6 sq.ft. area. Link-Belt conveyor, Cottrell precipitation.

Feedwater—Evaporated makeup, no chemical treatment. Two 380-gpm. Pennsylvania Pump & Compressor pumps driven by Westinghouse turbines.

Boilers—Two new Combustion Engineering bent-tube boilers, 700 psi., 825 F., of 80,000 lb. per hour rating each. Furnace volume, 3,550; boiler heating surface, 6,800; waterwall area, 910; economizer surface, 6,006; superheater surface, 1,678 sq.ft.

Fans—One Sturtevant forced-draft fan per boiler, motor-driven, vane control, 32,000 cfs. One Sturtevant induced-draft fan per boiler, vane control, 52,000 cfs.

Turbine—Westinghouse condensing turbine, 3,600 rpm. at 650 psi., 825 F., 28.5 in. vacuum. Three extraction points at (full load) pressures 74, 29.5, 9.4 lb. absolute.

Condenser—Condenser (Westinghouse) 12,000 sq.ft., water 50-85 F.

Generator—Generator 18,750 kva. at 0.80 p.f., 13.8 kv., air-cooled, water for fire extinguishing.

Scheduled operation November, 1940.

LAKE ROAD

Department of Public Utilities, Cleveland, Ohio

12,500-kw. (superposed) and 25,000-kw. (condensing), 650-psi., 825-F. units

Fuel—Pulverized 12,200 B.t.u. coal (ash fusion 2,000 F.) fed to two pulverizers and four coal burners (eight are oil) by Foster-Wheeler and Bartlett & Snow conveyors and hoppers, with Richardson scales. Prat-Daniel fly ash removal and Allen-Sherman-Hoff ash removal.

Feedwater—165 ppm. solids, not treated, supplied by four Ingersoll-Rand pumps of 375,000 lb. (233 F. water) per hour. Three motor-driven, one turbine-driven.

Boilers—Three Foster-Wheeler bent-tube boilers, 665 psi., 835 F., 300,000 lb. per hour, continuous slag tap. Furnace volume, 14,470; boiler heating surface, 20,628; waterwall area, 2,581; no economizer; superheater surface, 7,950; superheat control, General Regulator all-electric remote.

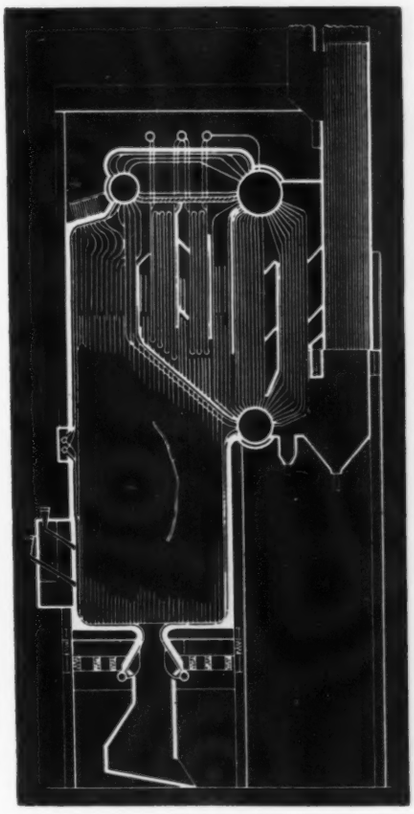
Fans—Two American Blower forced-draft fans per boiler, each 73,000 cfm., motor-driven, inlet vane control. Two American Blower induced-draft fans, each 121,700 cfm., motor-driven, outlet louver damper.

Turbine—One Allis-Chalmers topping turbine, 12,500 kw., 3,600 rpm., 650 psi., 825 F., and one Allis-Chalmers condensing turbine, 25,000 kw., 3,600 r.p.m., 650 psi., 825 F., 29 in. mercury with four extraction points at (rated load) 161, 74, 23 and 7 lb. absolute.

Condenser—Foster-Wheeler, 25,000 sq. ft.

Generators—Allis-Chalmers (12,500 and 25,000 kw. at 0.80 p.f., 11 kv.), air-cooled. Future installation of fire-extinguishing system.

Scheduled operation March, 1941.



GREENVILLE

Gas & Electrical Department, City of Norwich, Conn.

7,500-kw., 650-psi., 750-F. condensing unit

Fuel—Bunker C oil (150,000 B.t.u. per gallon) fed to two burners.

Feedwater—Hall Laboratories treatment of 75,000-lb. per day, solids 34 ppm. Two Ingersoll-Rand 175-gpm. feed pumps; one motor- and one turbine-driven.

Boiler—One Riley Stoker, bent tube, 75,000-lb.-per-hour, 725 psi., 750 F. Furnace volume, 3,650; boiler heating surface, 6,540; waterwall area, 1,970; no economizer.

Fans—One Sturtevant 22,200-cfm., motor-driven, forced-draft fan, vane control. One Green Economizer 33,800-cfm., motor-driven, induced-draft fan.

Turbine—General Electric, 7,500 kw., 3,600 rpm. condensing, 650 psi., 750 F., with extraction at 180 and 5 lb. absolute.

Condenser—Westinghouse, 5,750 sq.ft. for 38-88-F. river water.

Generator—General Electric, 7,500 kw. (at 0.80 p.f.), air-cooled, 4.6 kv.

Scheduled operation December, 1940.

STEEL POINT

United Illuminating Company, Bridgeport, Conn.

25,000-kw., 625-lb., 850-F. condensing unit

Plant designed in 1920 for 30,000 kw. Additions of 220-lb., 500-F. units (1925, 1927, 1929) and installation of superposed unit (625 lb., 850 F.) in 1936 brought total to 80,000 kw.

The 1940 addition consists of two steam generators to supply turbine operating on regenerative feedwater heating cycle with four steam extraction points to three closed heaters and one deaerating heater. Closed heaters designed to sub-cool drains to improve efficiency.

Spare boiler feed pump is turbine-driven. Fans are motor-driven; inlet vanes operated by combustion control system. Emergency fuel oil system for maintenance of full boiler rating despite outages of a pulverizer or coal feeder. Steam and feedwater cycle of unit independent of rest of station. Westcott & Mapes, Inc., designers of station, 1920-1940.

Fuel—Existing Robbins and Link-Belt coal-handling facilities employed. Two pulverizers and two burners per boiler. Coal 14,200 B.t.u., ash fusion at 2,575 F. Electrostatic precipitation.

Feedwater—Condensate of prior units for makeup. Three 717-gpm. Ingersoll-Rand feed pumps.

Boilers—Two new Babcock & Wilcox 650-lb., 850-F. boilers, each 300,000 lb. per hour. Dry bottom, bent tube. Furnace volume, 5,900 sq.ft.; boiler heating surface, 9,496; waterwall area, 2,158; superheater surface, 2,400. No superheat control, no economizer. Steam jet ash removal.

Fans—One 47,000-cfm. Sturtevant forced-draft fan per boiler with two-speed motor inlet vane control. One 82,500-cfm. Sturtevant induced-draft fan per boiler with two-speed motor, inlet vane control.

Turbine—General Electric 3,600-rpm., condensing turbine, 625 psi., 850 F., ½ in. abs. Four extraction points, 255, 140, 48, 11½ lb.

Condenser—Foster-Wheeler condenser, 21,450 sq.ft., using 34-80 F. condensing water (Long Island Sound).

Generator—General Electric, 25,000 kw. at 0.90 p.f., 13.8 kv., hydrogen-cooled, portable CO_2 fire protection.

Scheduled operation May, 1941.

BURBANK

Public Service Department,
City of Burbank, Calif.

10,000-kw., 625-psi., 825-F. condensing unit

Fuel—Oil or gas used in four burners per boiler.

Feedwater—Elgin and Permutit (Zeolite and acid) treatment of feedwater having 200 ppm. solids. Three electrically driven pumps (Union Steam Pump Co. and Byron-Jackson Co.) are one 200 gpm. and two 200 gpm.

Boilers—Two Babcock & Wilcox bent-tube 120,000-lb.-per-hour, 650 psi. and 825 F. Furnace volume, 4,460; boiler heating surface, 9,370; waterwall area, 1,400; superheater surface, 1,500. Bailey superheat control.

Fans—Sturtevant fans; one 40,000-cfm. forced-draft unit with duplex (two-motor) drive controlled by vane and motor selector. Induced-draft fan similar but 73,000 cfm.

Turbine—Allis-Chalmers 10,000-kw., 3,600-rpm. turbo-generator, for 625 psi., 825 F., with extraction at 223, 100, 35 and 10 lb. absolute.

Condenser—Elliott condenser with 8,000 sq.ft. for using 70-80 F. water in conjunction with cooling tower.

Generator—10,000 kw. (at 0.80 p.f.), 4.5 kv., air-cooled, with CO_2 fire-extinguishing system.

Turbine—Westinghouse, 67,500 kw., 1,800 r.p.m. condensing, 400 psi., 775 F., with extraction at (full load values) 176, 72, 23 and 6.3 psi. absolute.

Condenser—Westinghouse, 55,000 sq. ft., for 35-85 F. cooling water.

Generator—Hydrogen-cooled, 60,000 kw. (at 0.80 p.f.), 11.6 kv., with CO_2 fire-extinguishing system.

Scheduled operation July, 1941.

RAPID CITY

Dakota Power Company,
Rapid City, S. D.

3,000-kw., 455-psi., 750-F condensing unit

Fuel—Same as Jacksonville station (opposite page).

Feedwater—Flox Nalco treatment of feedwater. Two Worthington 125-gpm. feed pumps, one motor-driven, 1 turbine-driven.

Boiler—A duplicate of Jacksonville station unit.

Fans—One American Blower 17,500-cfm. forced-draft fan, motor-driven, Bailey control. One American Blower 32,500-cfm. induced-draft fan.

Turbine—Allis-Chalmers 3,000-kw., 3,600-r.p.m., 450-psi., 750-F. condensing turbine with extraction at 100 and 17 psi. absolute.

Condenser—Allis-Chalmers 3,000-sq. ft. condenser for 35-88 F. river water.

Generator—Allis-Chalmers 3,000 kw. (at 0.80 p.f.), 2,400-volt air-cooled generator.

Initial operation October, 1940.

Moderate-Pressure Plants

(400 psi. to 599 psi.)

REED (Unit No. 3)

Duquesne Light Company,
Pittsburgh, Pa.

67,500-kw., 400-psi., 775-F. condensing unit

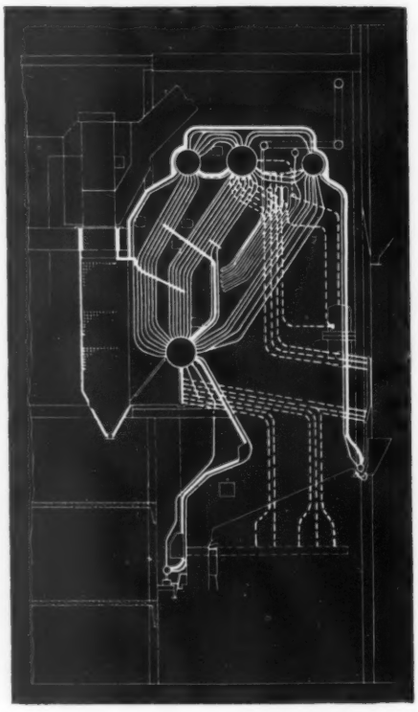
Ten years of development of details have made it possible to reduce the heat rate of Reed No. 2 to approximately 1,000 B.t.u. per kilowatt-hour below Reed No. 1, using the same nominal pressure and temperature. Reed No. 3 may show a slight improvement in heat rate over Reed No. 2. Both, however, constitute a continuation of the design established in 1928-29. The new Westinghouse underfeed stoker with a projected area of 730 sq.ft. is probably the largest in the country.

Fuel—Coal (13,000 B.t.u. and ash fusion 2,200 F.) is handled by additional (Webster) idlers and (Hewitt Rubber) belts.

Feedwater—Hall Laboratories treatment provided for the feedwater (solids less than 1 ppm.). One motor-driven 1,800-gpm. Ingersoll-Rand feed pump.

Boiler—One Babcock & Wilcox bent-tube, dry-bottom 350,000-lb.-per-hour, 475 psi. and 775 F. Furnace volume, 18,100; boiler heating surface, 28,143; waterwall area, 3,929; economizer surface, 7,520; superheater surface, 10,900. Hagan superheat control. Westinghouse ash sluicing system.

Fans—Two Buffalo Forge 68,500-cfm. forced-draft fans with motor and magnetic clutch, Hagan control. Two Buffalo Forge 125,000-cfm. induced-draft fans with Hagan control and motor drive.



OWENSBORO

Owensboro Municipal Utilities
Owensboro, Ky.

7,500-kw., 425-psi., 750-F. condensing unit

Fuel—Fairfield Engineering skip-hoist and gravity means for delivering 10,000 B.t.u. coal (1,850 F. ash fusion) to two pulverizers and two burners per boiler.

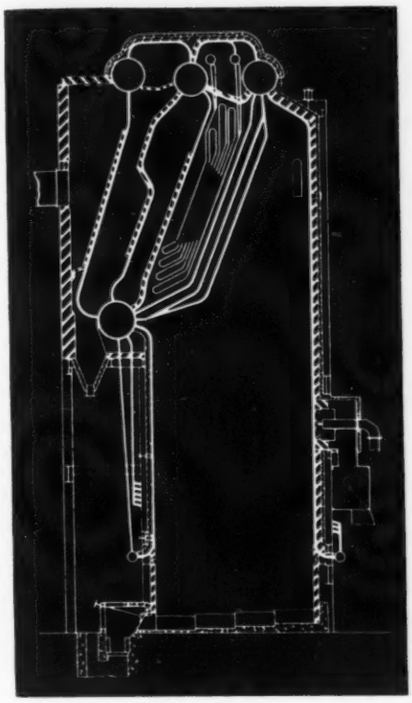
Feedwater—Lakeside Zeolite treatment of 70,000 lb. per day of feedwater (solids 1,000 ppm.). Three De Laval pumps, two (200 gpm. each) motor-driven, one (100 gpm.) steam-driven.

Boilers—Two Babcock & Wilcox bent-tube, dry-bottom boilers of 100,000-lb.-per-hour capacity each. Furnace volume, 7,470; boiler heating surface, 11,002; waterwall area, 2,128; superheater surface, 4,150; no superheat control. Hydraulic ash removal.

Fans—One Buffalo forced-draft fan per boiler, each 14,600 lb. per hour capacity, constant-speed motor and hand control. One Prat-Daniel induced-draft fan per boiler, each 185,000 cfm., variable-speed motor and diaphragm pressure control.

Turbine—Westinghouse, 7,500 kw., 3,600 rpm., condensing, for 425 psi. and 750 F. operation with extraction at 65 and 15 psi.

Condenser—Ross Heater & Mfg. Co. and Condenser Service Co., 10,000 sq.ft., 32-80 F. river water.



Generator — Westinghouse, 7,500 kw. (at 0.80 p.f.), 4,160 volt, air-cooled.

Initial operation August, 1940.

JACKSONVILLE

Gulf Public Service Co., Jacksonville, Texas

3,000-kw., 450-psi., 750-F. condensing unit

Fuel—Gas (974 B.t.u. per cu.ft.) and oil (19,700 B.t.u. per pound) supplied to four burners.

Feedwater — Two Worthington 175-gpm. feedwater pumps, one motor-driven, one turbine-driven.

Boiler—One Babcock & Wilcox bent-tube 50,000-lb.-per-hour, 455 psi., 750 F. Furnace volume, 2,220; boiler heating surface, 5,160; superheater surface, 34.

Fans—One American Blower 19,250-cfm. motor-driven, forced-draft fan with Bailey control. One American Blower 35,900-cfm. induced draft fan.

Turbine—One Westinghouse, 3,000 kw., 3,600 r.p.m., condensing, 450 psi., 750 F. operation with extraction at 100 and 17 psi. absolute.

Condenser—Westinghouse, 3,500 sq.ft., for 35-85 F. cooling water in conjunction with spray pond and cooling tower.

Generator — One Westinghouse, 3,000 kw. (at 0.80 p.f.), 2.4 kv., air-cooled.

Initial operation, September, 1940.

ATKINSON

Georgia Power Co., Atlanta

60,000-kw., 425-psi., 725-F. condensing unit

Fuel—Coal and natural gas, three pulverizers, twelve burners.

Feedwater—One Ingersoll-Rand 1,820-gpm., motor-driven pump.

Boiler—One Combustion Engineering bent tube, dry bottom, 650,000-lb.-per-hour, 460 psi., 750 F. Boiler heating surface, 32,200; waterwall area, 8,219; superheater surface, 13,200. Ash sluicing.

Fans — One Buffalo Forge, 210,000 cfm., forced-draft, motor-driven, vane control. One Buffalo Forge, 385,000 cfm., induced-draft, motor-driven, vane control.

Turbine—General Electric, 60,000 kw., 1,800 r.p.m., 425 psi., 725 F. condensing with four-point extraction.

Condenser—Wheeler, 62,250 sq.ft.

Generator — General Electric, 66,667 kw. (at 0.90 p.f.), 13.8 kv., air-cooled.

Scheduled operation November, 1941.

BRAINTREE

Municipal Light Department, Braintree, Mass.

7,500-kw., 425-psi., 625-F. condensing unit

Compactness of 3,600-rpm. unit advantageous for limited available space. Present 2,000- and 3,500-kw. machines afford opportunity to run new 7,500-kw. unit with excellent economy on base loads. Additional boiler capacity not needed and continuance of 425 psi. medium pressure advantageous under prevailing operating conditions.

Fuel—Oil of 18,000 B.t.u. per pound.

Feedwater—Two Ingersoll-Rand 260-gpm. feed pumps, one motor- and one steam-driven.

Turbine—General Electric, 7,500 kw., 3,600 rpm., condensing, 425 psi., 170 deg. superheat, with extraction at 10 lb. gage, maximum.

Condenser—Westinghouse, 10,000 sq.ft. for cooling water 34-70 F.

Generator — General Electric, 10,000 kva., 13.8 kv.

Scheduled operation December, 1940.

BUCKSPORT

Central Maine Power Co., Bucksport

15,000-kw., 400-psi., 750-F. condensing unit

Fuel—Oil, three burners used.

Feedwater—S. T. Powell phosphate, caustic soda and sodium sulphite treatment applied to 2,000,000 lb. per day of feedwater with solids 430 ppm. Three Warren feed pumps, one 450 gpm., turbine-driven; two 350-gpm., motor-driven.

Boiler—One new Babcock & Wilcox bent-tube boiler for 425 psi., 750 F.; capacity 150,000 lb. per hour. Furnace volume, 6,649; boiler heating surface, 13,800; waterwall area, 1,130; floor area, 460; air heater surface, 9,340; superheater surface, 2,370.

Fans—Bailey control on one end of Sturtevant fans. Forced-draft fan, motor-driven, 162,000 lb. air at 80 F., 6.8 in. S.P. Induced-draft fan, motor-driven (turbine initial start) 200,000 lb. gas at 400 F., 4.7 in. S.P.

Turbine—General Electric, 15,000-kw., 3,600-rpm., 400-psi., 750-F. condensing unit with extraction at 105, 56 and 10.6 psi., absolute.

Condenser — Westinghouse, 12,200-sq. ft. condenser using salt river water.

Generator — General Electric, 17,850 kva., 6.9 kv., air-cooled.

Initial operation August, 1940.

MOUND STREET

Laclede Power & Light Co., St. Louis, Mo.

20,000-kw., 400-psi., 710-F. condensing unit

Turbine—General Electric, 20,000 kw., 1,800 r.p.m., 400 psi., 710 F. condensing unit with extraction at 178, 88.8, 25.7 and 6.84 psi. absolute.

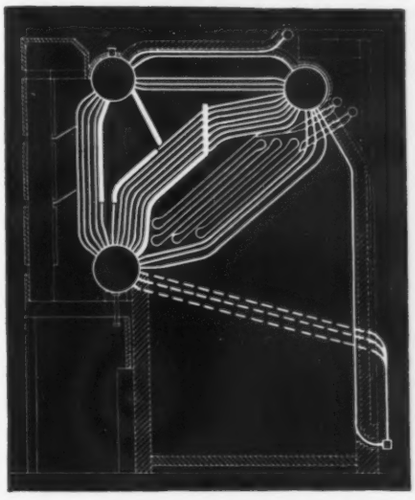
Condenser—Westinghouse, 29,600 sq. ft. for 34-85 F. river water.

Generator—25,000 kva., 0.80 p.f., 13.8 kv., air-cooled; steam fire-extinguishing system provided but not connected.

SCOTTSBLUFF

Western Public Service Co., Scottsbluff, Neb.

2,500-kw., 400-psi., 750-F. condensing unit



Objectives—Easy extension, complete automatic operation (bypassable in emergency), low-production-cost base-load plant. One operator per shift, having boiler control board, turbine gage board and switchboard in view. No pipes or conduit buried in concrete. Walls are largely insulated steel building panel. Significant also for 2,500-kw. unit is the relatively high steam conditions, two-point extraction, feedwater evaporator, hydraulic coupling for fan and supply of 55 F. well water, with circulation arranged to vary volume of water by automatically adding or removing a well.

Fuel—Gas (1,060 B.t.u.) and oil (18,000 B.t.u. per pound) fed to two Peabody burners.

Feedwater—Griscom-Russell evapora-

tor treats 7,500 lb. per hour of 295-ppm. feedwater. Two Ingersoll-Rand 105-gpm. feed pumps, one electric, one steam.

Boiler—Erie City, 450 psi., 750 F., 450,000 lb. per hour, with side walls and bottom air cooled, bent-tube. Furnace volume, 2,500; waterwall area, 354; economizer surface, 1,250; superheater surface, 1,390; no superheat control.

Fans—American Blower 20,200-cfm. forced-draft fan with constant-speed motor and inlet vane control. American Blower 31,700-cfm. induced draft fan with fluid coupling through V-belt to constant-speed motor.

Turbine—General Electric, 2,500 kw., 3,600 rpm., condensing, 400 psi., 750 F., 0.587 lb. absolute. Two points of extraction at 17 and 8 lb. absolute.

Condenser—Foster-Wheeler, 2,750 sq. ft., using 55 F. water from three 1,500-gpm. deep wells, lift 10 ft. static head.

Generator—General Electric, 2,500 kw. (0.80 p.f.), 2,400-4,150 volts, air-cooled generator.

Low-Pressure Plants

(400 psi. or lower)

McPHERSON

Water & Electric Department, City of McPherson, Kan.

5,000-kw., 390-psi., 675-F. condensing unit

Turbine—Addition comprises 5,000-kw. (at 0.80 p.f.) 3,600-rpm. Elliott turbine for operation at 390 psi., 675 F., and 2-in. mercury with three extraction points at (full load) 110.8, 71.2 and 13.4 lb. absolute.

Condenser—Westinghouse, 7,500 sq.ft., 80-85 F. water taken through forced and induced cooling towers.

Generator—5,000 kw., 4,160-volt unit, air-cooled (Griscom-Russell).

Scheduled operation, fall, 1940.

MANITOWOC

Public Utilities Commission, Manitowoc, Wis.

10,000-kw., 385-psi., 625-F. condensing unit

Turbine—Allis-Chalmers, 10,000 kw., 3,600 rpm., condensing for 385 psi., 625 F. operation at 5 psi. back pressure and extraction at four points.

Condenser—Allis-Chalmers, 12,800 sq. ft.

Generator—Allis-Chalmers, 10,000 kw. (at 0.80 p.f.), 4,160/2,300-volt, air-cooled.

DECATUR

Decatur Municipal Light & Power, Decatur, Ind.

5,000-kw., 385-psi., 725-F. condensing-extraction unit

Fuel—Coal (11,300 B.t.u. and 2,000 F. ash fusion) fed by Columbus flight conveyor to 212.7-sq. ft. chain grate stoker.

Feedwater—Elgin Zeolite treatment of 100,000 lb. daily. Two Ingersoll-Rand 200-gpm. each pumps, one motor-driven, one turbine-driven.

Boiler—One Wickes bent tube, dry bottom 70,000-lb.-per-hour, 400 psi., 725 F. Boiler heating surface, 7,750; waterwall area, 1,140; economizer, 2,250; superheater surface, 1,1615. Ash hopper and car removal.

Fans—One Green 30,000-cfm. turbine-motor-driven forced-draft fan. One Green 50,000-cfm. turbine-motor-driven induced-draft fan.

Turbine—General Electric, 5,000-kw., 3,600-gpm. condensing turbine, 385 psi., 725 F., four extraction points.

Condenser—5,300 sq.ft., cooling tower water 60-85 F.

Generator—General Electric, 5,000 kw. (at 0.80 p.f.), 2,400/4,160-volt, air-cooled.

Scheduled operation February, 1941.

NUECES BAY

Central Power & Light Co., Corpus Christi, Texas

7,500-kw., 375-psi., 875-F. condensing unit

Fuel—Gas of 1,099 B.t.u. per cubic foot.

Feedwater—Evaporated city water supplied to boiler by three pumps (two are 250 and 500 gpm. electric and one is 250 gpm. steam driven).

Boilers—Two boilers moved from another plant. These are each 425-psi., 85,000-lb.-per-hour Combustion Engineering bent-tube generators with seven burners. One has 725 F. and the other 835 F. superheat capacity. Boiler heating surface, 8,650; air-cooled walls; no economizer; 10,540 sq.ft. preheater; superheater surface, 2,700 sq.ft.; damper for control in 835 F. unit.

Fans—One Buffalo Forge 30,000-cfm. forced-draft fan per boiler driven by adjustable-speed slip-ring motor. One Buffalo Forge 50,000-cfm. induced-draft fan per boiler similarly driven.

Turbine—General Electric, 7,500 kw., 3,600 rpm., 375 psi., 835 F., 1.5 in. exhaust, condensing turbine with three extraction points at 123, 44 and 6.7 lb. absolute.

Condenser—Westinghouse, 8,500 sq.ft., uses 60-90 F. sea water.

Generator—General Electric air-cooled, 7,500 kw. (at 0.80 p.f.), 13.8-kv. generator.

Further details in subsequent article in ELECTRICAL WORLD.

Initial operation September, 1940.

NORTHEAST

Kansas City Power & Light Co., Kansas City, Mo.

35,000-kw., 275-psi., 725-F. condensing unit

This turbo-generator addition replaced a 23,000-kw. unit in the same space. Details were given in a series of articles beginning with October 19, 1940, issue of ELECTRICAL WORLD.

Turbine—General Electric, 25,000 kw., 1,800 rpm., operates at 275 psi. (prevailing plant pressure) and 725 F. with back pressure 0.735 lb. absolute. Three points of extraction at 120, 31 and 8.2 lb. absolute.

Condenser—Rebuilt with 33,650 sq.ft. for 32-85 F. water.

Generator—35,000 kw. (at 0.70 p.f.), 13.2 kv. with Trane air cooling.

Initial operation June, 1940.

RIVERVIEW

Panhandle Power & Light Co., Borger, Tex.

23,000-kw., 250-psi., 750-F. condensing unit

Fuel—Natural gas of 940 B.t.u. per cubic foot.

Turbine—General Electric 23,000-kw., 1,800-rpm., 250-psi., 750-F. condensing unit with extraction at 25 and zero psi. absolute, unit now being operated at 185 psi.

Condenser—Worthington, 25,000 sq.ft. for cooling water 50-90 F. in conjunction with spray pond and cooling tower.

Generator—General Electric, 23,000 kw. (at 0.80 p.f.), 13.2 kv., air-cooled.

Initial operation June, 1940.

GLENDIVE

Montana-Dakota Utilities Co., Glendive, Mont.

5,000-kw., 250-psi., 530-F. condensing unit

Fuel—Natural gas of 960 B.t.u. per cubic foot is used as fuel.

Turbine—One new 5,000-kw., 3,600-rpm. General Electric condensing turbine for operation at 250 psi., 530 F. and an exhaust pressure of 1.5 lb. absolute without extraction.

Condenser—7,400 sq.ft.

Generator—General Electric, air-cooled, 5,000 kw. (at 0.80 p.f.), 2,400 volts.

HIBBING

Water, Light, Power & Building Commission, Hibbing, Minn.

5,000-kw., 160-psi., 496-F. condensing unit

Turbine—Westinghouse, 5,000 kw., 3,600 rpm., condensing, 160 psi., 496 F., with automatic extraction at 40 lb. absolute.

Condenser—Westinghouse, 7,500 sq.ft., in conjunction with cooling tower.

Generator—Westinghouse, air-cooled, 5,000 kw. (at 0.80 p.f.), 2,400 volts.

Scheduled operation December, 1940.

Fluorescent at Polaroid Plant

Illumination intensity is doubled at virtually the same energy consumption — Layout adapted to varied service by motors and fluorescent lamps

H. D. BLAKENEY, Superintendent, Clark & Mills Electric Company, Boston Mass.

WHEN MOVING into a new location at Cambridge, Mass., the Polaroid Corporation faced the problem of adapting a five-story plant formerly manufacturing confectionery to the uses of an organization producing highly specialized lighting equipment and other output involving engineering research and precision methods. The new installation called for energy supply to 550-volt and also small fractional-hp. motors, with major lighting by 500 48-in., 40-watt, 115-230-volt, fluorescent tubes and some auxiliary illumination by tungsten lamps run off 115-volt circuits. All metering takes place at the incoming 550-volt, three-phase supply from the Cambridge Electric Light Company, and the new wiring layout was designed for flexible operation with ample facilities for meeting changes in the plant development on the several floors.

Incoming energy is controlled by a 600-amp. main switch in the basement, with leads to three 1,000,000-circ.mil insulated copper wire buses mounted in a trough from which 550-volt connections are made through 200-amp. switches to supply distribution cabinets through rigid conduit runs to the floors and load centers above. To provide 115-230-volt service, connections are made through a 200-amp. switch at the further end of the bus trough to the primaries of three 37.5-kva. delta-connected, air-cooled transformers adjacent to the switchboard center, and from the secondaries single-phase, three-wire, 115-230-volt risers of No. 3/0 copper are run to cabinets on the different floors for lighting and small power service. In general, the 550-volt, three-phase power feeds are of No. 4/0 copper, the branch circuits from the cabinets being No. 8 to No. 12 as required.

Flexible Layout

This arrangement enables the total energy used for various purposes to be metered in bulk and utilized as required by the Polaroid organization, conveniently with regard to internal changes in floor arrangements which may be dictated by progress in product design and manufacturing procedure.

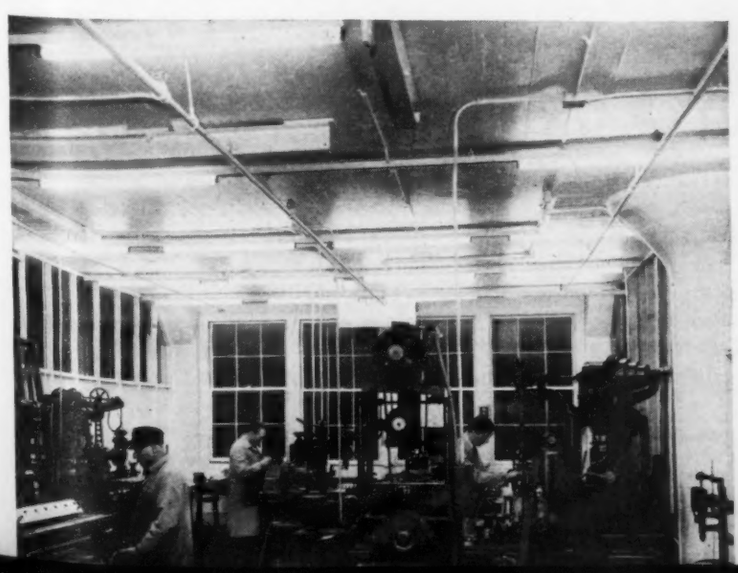
In studying the plant requirements it was found that the first cost of providing fluorescent lighting against ordinary incandescents was but one-third more. This was due to the fact that no reflectors were purchased by the Polaroid company, and also to the use of Curtis strip as a wire channel. In a laboratory test it was found that the general illumination was increased by doing away with reflectors and painting the Curtis strip, ceiling and side walls a dull white.

In general, branch lighting circuits use No. 1 Curtis strip with covers, auxiliaries and duplex receptacles flush with the bottom of the strip. This allowed tap-offs to desks when required without the necessity of having any wires on the floor. All these receptacles are of the twist-lock type.

About the only trouble encountered with this installation was the matter of hum, which was decreased to a negligible minimum by removing the clips holding the auxiliaries and floating them in rubber and Celotex. On the first floor acoustic strip was used, all Curtis strip being mounted flush

[*Continued on page 121*]

Machine shop at Polaroid plant utilizes 35 ft.-candles from fluorescent lighting installed without reflectors in Curtis strip



General office illumination by 40 fluorescents supplemented by Polaroid desk fixtures which are connected to branch circuits of Curtis strip

Switch Impulse Strengths Parallel Insulator Values

Tests show little foundation for common belief that switch assemblies require individual tests because configuration of parts will detract from impulse strength of insulator units

ELIAS S. CORNELL, Delta-Star Electric Company, Chicago*

COMPREHENSIVE TESTS of high-voltage switch designs demonstrate there is little justification for requiring tests of individual designs to determine their ability to withstand impulse flashovers. Contrary to common belief, it appears from these tests that the values determined from conventional impulse tests of the insulator units built into switch designs are a reliable and adequate index of the performance of switch assemblies and mountings of widely diverse nature. To a considerable extent the results of these tests should prove helpful in facilitating insulation co-ordination by eliminating the element of doubt which has been attached to high-voltage switches as contrasted with accepted performance of other pieces of equipment at terminals and switching points.

In preparing for the tests it was decided we were not so much interested in the actual impulse strength of the various assemblies as we were to obtain comparative data of typical switch assemblies and insulator units used in these switch assemblies when these insulators were tested as specified in the A.I.E.E. specifications.

Equipment and insulators of five typical voltage ratings were selected for tests. In all instances manufacturers' standard insulators were used, as follows:

Rating, Kv.	Insulators Ohio Brass Cat. No.
15	31301
34.5	31548
69	(2) 31549
115	(3) 31152
161	(4) 31152

Standard vertical break switches with conventional operating mechanism fittings were tested both in upright and underhung mounting, Figs. 1 and 2. Assemblies are illustrated in Figs. 3 and 4, consisting of two insulators mounted on standard switch channel bases and with steel straps connecting them. These correspond to the simplest form of disconnecting switch and give about as poor clearance conditions as would ever be found in switch designs.

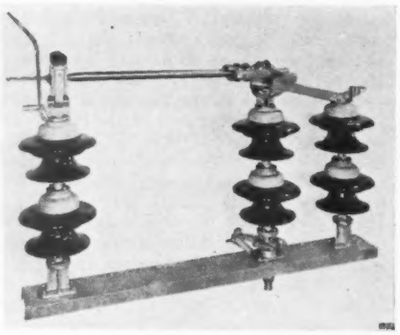


Fig. 1—Upright vertical break switches like this were tested

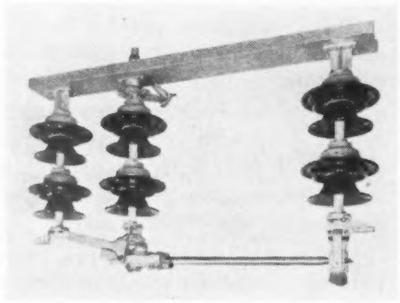


Fig. 2—Tests included underslung vertical break switches

The A.I.E.E. test set-up consisted of a single insulator unit mounted upright on a wide steel channel base, a round conductor of proper dimensions on top of insulator and the conductor axis 90 deg. to the channel axis.

Both Wave Polarities

In all instances the various assemblies were tested with both positive and negative standard ½-40 impulse wave. The voltage applied started at sufficiently low values so that no flashover occurred. The voltage setting was then raised in small steps until the critical flashover value was determined. This is the lowest voltage which 50 per cent of the time causes flashover of the assembly under test.

Many tests were made at each voltage setting. To get a true comparison between the various assemblies the critical flashover values were used.

Tests were conducted in groups, each consisting of tests of all assemblies having the same voltage rating and identical insulators. First, the single insulator in the A.I.E.E. standard set-up was tested, followed by test of assemblies shown in Figs. 1 to 4 and ending by repeating the A.I.E.E. test of the single insulator. The tests on each group were conducted in rapid succession. The whole group was completed within a span of a few hours to insure that atmospheric conditions affecting the results would remain substantially unchanged.

The identical critical flashover values obtained on the single insulator tested at start and finish of each test group proved that test con-

* Chief engineer.

ditions had remained unchanged.

All critical flashover values were tabulated and the ratio of critical flashover on each of the various switch assemblies to critical flashover of the individual insulators was established. If critical flashover of switch assembly and insulators alone were equal, this ratio would be 1.00. A ratio higher than 1.00 would indicate that the switch assembly had a higher critical impulse flashover value than the insulator alone. A condensed tabulation is given in the accompanying table.

Derating Unnecessary

It is not the purpose of this article to attempt any theoretical explanation of the results obtained by the tests, except that the results can undoubtedly be attributed to a better field distribution and less field concentration when several insulators are placed fairly close together. This field distribution is possibly still further improved by switch parts mounted on the insulator.

The practical conclusions that can be drawn from this test are far more important. It assures us that critical flashover values as given for individual high-tension insulators can be used for switch apparatus and bus supports without derating. It is interesting to note that this condition is not true when switching equipment is tested for 60-cycle flashover values, where it is often found the 60-cycle flashover for assembled switching equipment is somewhat lower than the 50-cycle flashover value of insulators tested in standard A.I.E.E. set-ups.

As previously stated, the critical flashover values were in all instances used for comparison and for determining the various ratios given in the table. Today's specifications, however, do not use critical impulse flashover but, rather, maximum withstand impulse strength. This is the highest impulse voltage which can be applied to a piece of apparatus without flashover taking place. Naturally, results and ratios obtained for the critical flashover voltage as outlined in this article are equally correct for withstand voltage.

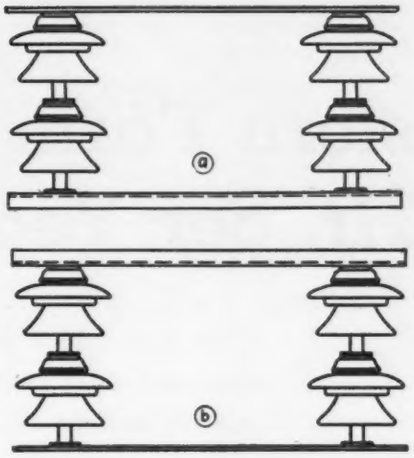


Fig. 3—Assemblies simulating simple disconnects were also compared with single (A.I.E.E. test) insulators. (a) Upright. (b) Inverted

Insulator Test Suffices

A practical conclusion for engineers and buyers when specifying tests on equipment to be made is that it is unnecessary to have withstand impulse tests conducted on the great variety of equipment using identical insulators and that a test of typical insulators used in this assembly will suffice.

Naturally the buyer will benefit directly in time savings and the cost of equipment if unnecessary tests are eliminated.

Tests similar to those outlined have been conducted by others with substantially the same results. Apparently the results have not been published and we feel that the data should be made available, particularly since the co-ordination of insulation of all types of equipment is so much discussed.

We wish to express our appreciation to the Ohio Brass Company for its courtesy in extending the services of its laboratory, and thank P. M. Ross, superintendent of the high-voltage laboratory of the Ohio Brass Company for his splendid co-operation.

Ratios of Positive Polarity Critical Flashover Values in Kv. of Assemblies 1 to 4 to Corresponding Flashover of Single Insulator.

Kv. Rating	15	34.5	69	115	161
Ins. (A.I.E.E)	1.00	1.00	1.00	1.00	1.00
Assembly I	1.11	1.03	1.16	1.03	1.00
Assembly II	1.64	1.29	1.15	1.13	1.09
Assembly III	1.02	1.01	1.15	1.00	1.01
Assembly IV	1.37	1.10	1.10	1.07	1.04

Semi-Storage Air Conditioning

[*Continued from page 46*]

a little greater efficiency of the compressor might have been obtained.

Advantages and Disadvantages

At present there are, of course, advantages and disadvantages both to the consumer and the power company in the use of storage air-conditioning equipment.

To the consumer the storage system means lower connected load with corresponding lower demand charges in case the customer is on a demand rate. It also means more dependable performance in extremely hot or humid weather, when conditions might exceed design conditions used for a conventional system. In the case of an installation designed for few hours of operation per day or per week, the initial cost of the storage system will likely be less than that for a conventional system. However, progress of the past year indicates that the difference in initial cost is becoming less as more attention is being given to the design of storage systems. It should be borne in mind that storage installations today are necessarily composite, "tailor-made" jobs, whereas most of the smaller conventional jobs are now "package" units, self-contained and engineered at the factory. This condition accounts for much of the difference in initial cost. There are, however, some encouraging reports that a few manufacturers are now giving consideration to "package" equipment for storage jobs.

Space requirements may be a disadvantage to the customer, although the extra space required may often be found in existing waste space, as was the case in the test installation described here; a corner of the garage on the first floor of the building, which was not usable for car storage, provided space for the tank and compressor.

Greater energy consumption is naturally a disadvantage to the cus-

[*Continued on page 121*]

Typical Eastern Farm Employs 13,650 Kw.-Hr. per Year

Joint rural usage experiment by Westinghouse and Rochester Gas & Electric results in two-year performance records reported on 22 meters — Two-cent rate is goal

CARL E. JEERINGS, Rochester Gas & Electric Corporation, Rochester, N. Y.*

A TYPICAL Eastern dairy farm making use of practical modern labor-saving conveniences will use approximately 13,650 kw.-hr. per year.

Such is the experience on the Peet Farm, located on the lines of the Rochester Gas & Electric Corporation, a co-operative field test to determine the use and value of present-day farm equipment, under the sponsorship of the Westinghouse Electric & Manufacturing Company, New York State power and light committees, Farm and Home Bureaus, sixteen co-operating electrical manufacturers and our utility company.

Twenty-two meters are located on the Peet Farm and cumulative readings for the second year are given in the appended table.

We feel these figures are of value because (1) they are actual performance figures, (2) derived under ordinary farm operating conditions. The farm consists of 147 acres, with farmhouse, barns, silo, garage, milkhouse, etc. with fourteen cows, six horses, a gasoline tractor, one truck, two spray rigs and two passenger cars. Two sons live with the parents and there are one or two hired hands also living on the place.

* Rural service supervisor.

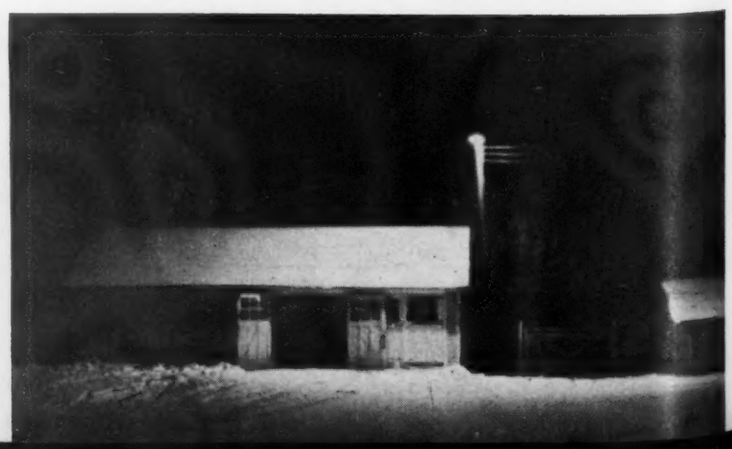
There is nothing "fancy" about the Peet Farm. What we all sought for this test was a typical farm where ordinary farm routine was the order of the day, where the people bought only those appliances and equipment that they could use profitably and where in addition use would be made of the installed facilities only at such times as the customer considered such use to be of value.

Many Visitors

We have found that our customers also are more interested in a farm of this nature than they would be perhaps in a more pretentious farm. In this particular we have been ably assisted by the extremely co-operative receptiveness tendered to visitors by Mr. and Mrs. Peet, owners and operators of the farm.

Many visitors, announced and unannounced, have appeared at the farm to be shown around the place. Groups and in fact entire classes of school children have visited the farm, transported via school buses. Pupils from

Rochester Gas & Electric and Westinghouse Electric & Manufacturing Company encouraged the installation of farm equipment that was practical and useful



Analysis of Consumption During Second Year of Farm Operation With Electrical Equipment

(Readings are Cumulative)

Meter No.	Location	1939 Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	1940 Aug.
8.....	Kitchen under cooker.....	0046	0053	0055	0058	0063	0065	0068	0068	0076	0076	0078	0086
1.....	House.....	6100	6559	7028	7618	8200	8696	9204	9760	0316	0880	1398	2038
2.....	Shallow well pump.....	0008	0009	0009	0010	0011	0012	0012	0014	0014	0014	0016	0019
26.....	Shallow well pump*.....	009750	010400	011140	011970	012780	013420	014030	014980	015840	016920	018020	019530
3.....	Deep well pump.....	0411	0444	0476	0530	0583	0650	0728	0776	0820	0856	0894	1014
28.....	Deep well pump*.....	069240	069240	069240	073390	077760	Removed						
4.....	Water heater — house..	0832	0998	1169	1385	1604	1795	1966	2180	2390	2614	2822	3055
27.....	Water heater*.....	008410	009090	009700	010460	011190	011710	012330	013190	013970	014920	015900	017160
5.....	Range.....	1410	1554	1678	1812	1925	2020	2130	2282	2460	2662	2844	3010
6.....	Dishwasher.....	0009	0009	0009	0009	0009	0009	0009	0009	0009	0009	0009	0009
7.....	Refrigerator.....	0225	0244	0260	0275	0289	0301	0312	0326	0344	0368	0392	0430
10.....	Guest house.....	0620	0622	0624	0624	0624	0629	0632	0634	0636	0640	0642	0740
11.....	Milk house.....	6555	6975	7378	7758	8157	8558	9002	9548	0026	0578	1076	1543
12.....	Milk cooler.....	1303	1433	1516	1599	1666	1730	1796	1872	1962	2132	2280	2432
13.....	Sterilizer.....	0919	0984	1041	1069	1092	1119	1162	1242	1318	1394	1465	1538
14.....	Water heater — barn.....	1365	1574	1821	2068	2349	2604	2918	3284	3578	3870	4136	4360
29.....	Water heater*.....	013460	014310	015240	015860	016160	016750	017520	018450	019290	020410	021520	022610
18.....	Barn.....	2324	2503	2658	2835	2998	3164	3289	3432	3568	3650	3736	3824
19.....	Milker.....	0617	0667	0717	0776	0833	0895	0952	1006	1054	1102	1143	1187
20.....	Feed grinder.....	0402	0429	0457	0479	0496	0512	0526	0541	0564	0580	0598	0609
22.....	Poultry house.....	0678	0678	0707	0741	0771	0801	0813	0824	0824	0824	0824	0824
23.....	Shop.....	0058	0060	0062	0064	0266	0619	0655	0658	0658	0664	0670	0673
21.....	Barn — upstairs.....	0162	0246	0246	0247	0247	0247	0247	0249	0249	0249	0254	0254
15.....	Milk house fan.....	0051	0053	0053	0054	0058	0061	0065	0072	0078	0080	0080	0082
24.....	Cow stable fan.....	0242	0248	0249	0280	0299	0329	0343	0382	0424	0434	0425	0436

* Gallons of water.

vocational agricultural schools, members of 4-H Clubs and Farm Bureau members have also visited the farm. In addition we have a set of slides which we project at dealers' meetings and grange meetings. So we feel that the farm has a large promotional value.

People who visit the farm ask about the bill and about the usage of various equipment. The electric bill for all services runs between $25 and $30 per month. This is quite profitable, the Peets say, because they formerly spent $30 a month just for ice and for oil for the oil stove.

These visitors see a typical farm—not large, not small—where the range uses about 103 kw.-hr. per month, a 9-cu.ft. refrigerator about 16 kw.-hr. per month and where it takes about 51 kw.-hr. per month to milk fourteen cows. They see that where three men formerly did the milking, only one man is needed now.

It is ordinary information such as this, based upon actual experiences, which is passed around at these get-togethers. The cost to us has not been high as Westinghouse was responsible for the equipment originally, which was to be purchased by the customer at the end of the first year. The customer installed the equipment and he pays the regular service bill. The company supplies the meters, reads the meters, keeps the records and supplies facilities, especially transportation, necessary for visits of groups and individuals to the farm.

The average rate paid is about 2.9 cents per kw.-hr. and peak demand of 11 kw. has been imposed on the 15-kva. CSP transformer. A new off-peak water heater installation is expected to lower the over-all rate to about 2 cents.

Adequate Wiring First

The Peet Farm was typical of most farms in that it presented a concrete example of where the first job with the customer must be done.

Mr. Peet had installed wiring in the barn and other buildings just before we started this venture and could not understand why so much of this should have to be changed. A great deal of credit is due the Anaconda Wire & Cable Company for its help in making recommendations and in supplying 1,500 ft. of Durax nonmetallic sheathed cable, 600 ft. of service cable, 3,000 ft. of triple-braid

[*Continued on page 123*]

Views show electric washer and ironer in the farm kitchen, automatic water pumping and water heater in the cellar, hay hoist out in the barn substituting for a gasoline tractor and extra hired help, motor installation in barnyard for cutting hay, filling silo and other tasks, and yard lighting.

Editorials

S. B. WILLIAMS, *Editor*

A Suggestion for Making Utility Act Effective

EARLIER in the month the new chairman and president of the Standard Gas & Electric Company talked before the Wisconsin Utilities Association on federal regulation of power companies under the five-year-old utilities act. The address, which is reprinted in this issue, is significant for several reasons.

In the first place it was made by the chief executive of one of the largest holding companies with subsidiaries and affiliates in California, Oregon, Colorado, Oklahoma, Minnesota, Wisconsin, Kentucky and Pennsylvania.

Secondly, it is the first speech of any note on this subject to be made after President Roosevelt's re-election.

Thirdly, this gentleman stands high in the councils of the New Deal and as head of the Federal Deposit Insurance Corporation and, as a member of the commission that worked out the banking regulatory problems during the trying period of the first term of the New Deal, he is regarded as one of the Administration's inner circle.

Whether the rumor that this address had the President's notice and approval before its presentation is true or not, the circumstances surrounding it make it a document worthy of careful study by all utility people.

While there is plenty of frank talking in the address, there is not one harsh or vindictive or threatening note. It is an appeal for common sense on both sides in the administration of a law on the statute books using as a background the means employed in effecting federal regulation of banking.

Analogies are drawn between the administration of banking and utility legislation which should give the industry courage. The first banking law was not good, but in two years this was remedied after the banks and government by working together had found what would and what would not work. Basic reforms in banking and bank rehabilitation resulted, it is stated, while with utilities there has been no reform or rehabilitation.

The address unquestionably reflects the Administration's point of view in the statements:

1. That financing for extension or even refinancing by companies with preferred dividend arrearages will have to wait upon a resetting of debt and capital conditions.

2. That arbitrary write-up, overcapitalization, skimping on depreciation and otherwise using improper methods can no longer be tolerated.

3. That the day of pyramiding corporate structures, extortionate service, management and construction contracts with subsidiaries and unjustifiable inequalities in the distribution of voting control are drawing to an end.

Likewise is the hand of Washington suspected in the statement that administrators' prerogatives include no room for the arbitrary application of their pet theories, as well as in the statement that executives of corporations have no right to defy laws in conflict with their own personal views.

In the court of public opinion there would be little sympathy for any one who opposed these principles.

There are other problems in the administration of the act dealing with integration, disposition of properties, management, service and control which are not clear-cut in nature. To work these out to the satisfaction of the public, the industry and the investors it is proposed that the industry sit down with those administering the law and jointly work out a program for accomplishing as much of the job as possible under the existing law.

This appeal to common sense is aimed not only at utility executives but at the administrators of the law as well, for it is stated, and we have to remember the hand of Washington, that an open-minded attitude on the part of the government as well as much common sense interpretation will be necessary to make the act useful to the public, to the utility industry and to the utility investor. And add to this the statement that integration provisions will have to be administered with a fine sense of reason, balance and timing and knowledge if the act is to prevent abuses and not to turn back pages of history.

This proposal is both reasonable and timely. Nothing is to be gained by uncompromising conflict. Lack of confidence in the sincerity of the Administration has brought about a reluctance to try to make the law work in its present form. If this address was inspired, then the fear that has held the utilities back should be lessened.

One important drawback to the suggestion is lack of leadership and cohesion within the utility industry. Each company considers its problems are its own problems. And so they are, but nevertheless there are certain fundamental principles and practices that can be accepted by all who are sincere.

For the past five years the utility act has hung like a sword over the head of the utility industry. It has depressed security values, hindered financing and expansion, worried the employees and caused a continuation of the bad feeling between the industry and government. It is time that the whole thing was cleared up so that the industry can again go forward on firm footing.

If the Administration is seeking co-operation in the administering of the act the industry should with equal sincerity accept the suggestion. It might be surprised to see what can be accomplished that way. If with an honest and sincere effort at co-operation the act cannot be made to work, then the industry can with clean hands go to Congress for remedial legislation.

Protection Against Saboteurs and Spies

J. EDGAR HOOVER, director, Federal Bureau of Investigation, has asked us, along with other business papers, to urge manufacturers engaged in producing defense materials to strengthen their protection against sabotage and espionage.

The F.B.I. for more than a year has been making surveys of the protective facilities of industrials with large defense contracts in order to make recommendations for strengthening their protection. In line with this work and to extend the area of its suggestions the bureau has prepared a comprehensive booklet entitled "Suggestions for Protection of Industrial Facilities."

Obviously such a book cannot be circulated indiscriminately. It can be obtained upon written request from the Federal Bureau of Investigation, Washington, D. C., by any executive officials of concerns manufacturing defense materials under government contracts.

Industry has a responsibility to protect itself against saboteurs and spies. It is only in that way that full speed can be given to the defense program. Both executives and workers must be on the alert to guard against these two enemies of defense preparations.

The enemy within by dislocating or slowing up production of essential materials frequently can do more harm than any armed enemy without. We urge manufacturers with defense contracts to get this new F.B.I. book, study it and put its recommendations into effect.

Realistic Approach to Depreciation

UNDER the Uniform System of Accounts prescribed by the Public Utilities Commission of Connecticut and effective the first of January, depreciation is defined as "the loss not restored by current maintenance which is due to all factors causing the ultimate retirement of the property. These factors embrace wear and tear, decay, inadequacy, obsolescence, requirements of public authorities or public opinion, fire, hurricane, flood and other casualty."

This definition differs sharply from that of some other regulatory authorities who contend that depreciation is money paid by consumers as property liquidation and therefore should be deducted from the investment account to arrive at the rate base—the cost net viewpoint. In the Connecticut definition depreciation is simply insurance against property loss from whatever cause.

The difference in the two viewpoints probably lies in experience, for during the past few years Connecticut has been severely visited by the elements three times—once by flood, two years ago by hurricane and last winter by sleet. Such widespread property destruction causes one to look upon unpredictable retirement with realism when it comes to setting up depreciation reserves.

Retirement of property, whether by storm, obsolescence, public demands or ordinary wear and tear, is still retirement, and as such must be covered. We hope it will not require a further series of acts of God to give our regulatory authorities a more realistic concept of depreciation.

Floating Power Plants

EVER SINCE the warship *Lexington* helped out the city of Tacoma with power during a water shortage in 1929 and the good ship *Jacona* was connected to the lines of the Public Service Company of New Hampshire a year later, and still operating, the idea of a floating power plant has been brought forth periodically as a mobile source of emergency power. Only recently General Electric announced that it was studying a 50,000-kw. self-contained plant on a vessel that would pass through the New York Barge Canal and could be used on both inland and coastal waterways.

The value of such plants would appear to lie in their mobility, over-all economy, short time and stand-by availability. How great would be their emergency value would depend upon the suddenness and duration of the emergency. In disasters such as floods and hurricanes it is frequently found that the local distribution system is incapable of handling power for the period that local generation is out. Under such circumstances it might be more profitable to have a multiplicity of small mobile units for local use.

How valuable the mobility of such plants would be to aid in handling a peak likewise depends on conditions. Many communities, for instance, experience their peak during a time of the year when inland waterways are apt to be closed.

On the other hand, situations might arise when an extra 50,000 kw. for a short time would save a company from an embarrassing situation. A floating plant might serve as a spinning reserve for a number of plants bordering on the same or nearby waterways to cover overhaul periods. It could be used as a temporary reserve pending location of a land plant or to handle a suddenly acquired large load until a permanent source were available.

One of the greatest possibilities of such plants is as quick sources of power to areas that have suffered power plant damages from equipment failure, fire, sabotage or bombing. Several such plants over the country could be justified on that basis alone.

Fuel economy at 12,500 B.t.u. or less, while not up to the best of the land stations, is better than that of many existing plants. Fixed charges should be below those for land plants because of no land investment, conceivably lower building cost and simpler design. Other possibilities for savings lie in taxes and in coal storage.

Judging from the new capacity being installed, two and a half million kilowatts of which is briefly detailed in this issue, and from the monthly peak and reserve studies, the above analysis would not appear to justify additional capacity in the form of floating plants as a defense preparedness measure except perhaps as a floating insurance of reserve adequacy.

Burning the Barn to Kill a Few Rats

By CARTER FIELD

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him

PROPOSAL of the American Telephone & Telegraph Co. to sell somewhere between $100,000,000 and $150,000,000 of new securities direct to a group of insurance companies has stirred up much interest in Washington.

It is probably too much to hope for that this interest will result in real reform soon, but certainly it is paving the way to some vitally needed changes in the present practices of the SEC and other government bodies which have to do with regulating and questioning corporations.

Of course the move will stir up a counter activity as well. Many of the left wingers in Washington have been biding their time, with a little preliminary harassing through the Monopoly Committee on the side, until the day when the government would do considerably more regulating of the insurance companies.

Too Expensive

But the point, of course, is why the telephone company is following this course. The answer is so obvious that there is no dispute about it. The telephone company and most other corporations did not resort to this type of financing until SEC regulation and laws made the old system too expensive, too dilatory and too dangerous. Dangerous in the sense that any wording of the applications, briefs, circulars or advertisements which did not appeal to the officials of SEC might result drastically so far as the vital element of time is concerned, even if nothing worse intervened.

But the pressing need of the Treasury for additional revenue adds another interesting factor to the situation, and it is this one which is rousing some interest at the moment on Capitol Hill. The point here is that the federal government spends a huge sum, probably approaching $100,000,000 annually, though any computation runs into arguments and dispute as to the details, in obtaining this information from various corporations. This figure, of course, is estimated not on SEC alone, but for all government agencies which require reports of various sorts from corporations.

A conservative estimate obtained by ELECTRICAL WORLD some time back was that the electric companies of this country alone were compelled to spend about $10,000,000 a year on unnecessary reports to various government agencies. It was estimated at that time for a former government official that it cost the government, in obtaining and handling these unnecessary reports, about $2,000,000 a year.

At the present time the federal corporation income tax is 24 per cent. So that, at present, it not only costs the government $2,000,000 to get this unnecessary reporting from the electric companies, but $2,400,000 in corporation income taxes in addition, since obviously if the money were not spent for these reports it would appear in the taxable net earnings.

That, of course, is only part of it. The $7,600,000 which the electric corporations would have left, after paying taxes, would of course be paid out, in part at least, in dividends. Every dollar of these, practically, would then be taxable in personal income returns. And bear in mind that every dollar of these would be in the top brackets of those persons receiving them.

So that, all in all, these unnecessary and harassing reports represent a very stiff charge to the federal treasury, and at a time when the lawmakers on Capitol Hill are racking their brains to figure out new imposts.

There are lots of little absurdities about the excessive cost of this regulation of electric corporations—others too—but for obvious reasons the electric companies have been the worst sufferers. For instance, when a company wants to issue some new securities, it is not enough to inform the SEC in a clearly written letter of what is desired. Arguments, explanations and discussions running to the stage of absurdity have to be printed.

Why printed? Nobody knows. Certainly it would seem that if a number of copies are required by the government mimeographing would be sufficient. Perhaps the explanation lies in the desire to be just as dignified as the Supreme Court of the United States, which has always required printed briefs. But the Supreme Court has traditions to maintain. It still supplies quill pens for attorneys appearing before it, just as the Senate still has sand on each desk for blotting, and never used snuff boxes, one for the Republicans and one for the Democrats!

Former Procedure

In the good old days, before SEC, the telephone company would have done this new financing very simply. Its practice was to issue rights to all common-stock holders. If the stockholders wanted to buy some more stock they exercised their rights. If they did not, they sold the rights, which thus amounted to an extra dividend.

To do that now would cost an appalling amount of money in getting the new issue approved by the SEC, the reason, theoretically, being to protect American investors from being robbed! But there is another point. Some statement in the various papers which have to be prepared and filed might provide an excuse for some new investigation, and then the company would have to spend some real money defending itself before the inquisitors and justifying itself in advertisements to the public.

But how we love to burn down the barn to get rid of a few rats!

NEWS OF THE WEEK

FPC Conducts Inquiry in Opposition to PUDs

Investigation of alleged political activities of private utilities in Pacific Northwest reveals expenditures of more than $1,000,000 — Five companies under probe

Activities of private utilities operating in the Pacific Northwest in combating the spread of public utility districts fostered as outlets for Bonneville and Grand Coulee power have been spread on the public record by the investigation of the Federal Power Commission which has been in progress since before the November 5 election.

With the PUD question occupying a prominent place on the ballot, the FPC group came to the assistance of public ownership advocates in the area by probing into the alleged charges that the utilities were spending large sums to defeat the formation of PUDs. Since the election the investigation of alleged political activities has continued.

Make Contributions

It has been brought out in testimony that the utilities contributed to expenses of the Washington Taxpayers Association, Let the People Vote League, Northwestern-Pacific Employees Protective Association, formed by 60 employees to protect their jobs, Washington Business and Investors, and Oregon Business & Investors in opposition to the spreading of the PUDs.

Evidence has been produced to show that Pacific Power & Light, Northwestern Electric and Portland General Electric spent more than $266,000 to defeat PUD elections in the five years 1935-40. Portland General Electric spent $96,500 in fourteen PUD and municipal power elections, it was brought out.

Paul B. McKee, president of Pacific Power & Light, said that expenses of his company and those of Northwestern Electric in defeating PUDs were charged to income and not operating expenses.

A summary of expenditures was entered for the past five years by Pacific Power & Light at $159,575 and by Northwestern Electric at $176,810. Expenses by the other three companies now under investigation—Washington Water Power Co., Puget Sound Power & Light Co. and Portland General Electric Co.—are expected to be disclosed during hearings.

So far the hearings have been marked, at times, by clashes between FPC attorneys and witnesses and testimony regarding the procedure used by the utilities in opposing public ownership. The commission has held hearings in Oregon and the state of Washington.

Trial Examiner Samuel H. Crosby and Chief Counsel Lambert McAllister summarized results to date by announcing that they had probed expenditures totaling more than $1,000,000 for the period covered by the investigation. A fact-finding report is to be made at the conclusion of the hearings.

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Court Upholds 30% Rate Cut for Tampa Electric

Circuit Judge Ira A. Hutchinson of Panama City, Fla., has handed down a ruling upholding the basis of a 30 per cent cut which the Tampa utility board ordered in the rates of the Tampa Electric Co. The court ruled (1) the company's investment for ratemaking purposes cannot include its street car system or any other property except that which is "used or useful" in distributing electricity within the city and (2) that this property should be figured at its present "fair value" rather than at its original cost.

Judge Hutchinson made his ruling on motions by the utility board to dismiss the injunction suit and to strike out parts of the bill of complaint. The judge denied the motion to dismiss, but struck out those sections of the bill of complaint dealing with the 5-cent carfare and certain other contentions. The judge ruled with the electric company in that the 1939 law creating the utility board makes it mandatory that the rates allow the electric company a 7 per cent return on its investment.

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P.G.E. Denies Link With North American

Testimony to the effect that neither management nor policies of Pacific Gas & Electric Co. have been controlled or influenced by the North American Co. was presented by several witnesses at a series of SEC hearings in San Francisco. The hearings were on an application of P. G. & E. for exemption as a holding company under Section 2 (a) 8 of the holding company act. The company asked for exemption from registration as a North American subsidiary. The latter is the largest holder of P. G. & E. securities, owning about 17.2 per cent of the company's outstanding common and preferred shares.

History of the company was traced from its beginning, with particular emphasis placed on the purchase of Great Western Power and San Joaquin Light & Power Corp. from North American by P. G. & E. through an exchange of securities. Testimony was introduced by P. M. Downing, vice-president and general manager, to show that economies

in operation and lower rates to customers resulted from the consolidation.

Of particular interest was the stand taken by the California Railroad Commission, which entered a 6,000-word statement into the proceedings indicating that at no time in the history of the commission's regulatory dealings with the company had there been any indication of outside control or influence. The statement outlined the authority exercised by the California Commission over rates, accounting practices and security issues. It pointed out that all of the P. G. & E. properties are located within the state of California and that its facilities were physically interconnected and co-ordinated into an efficient system. The statement was signed by Commission President Ray L. Riley and Ira H. Rowell, attorney.

Anticipating considerable public interest in the hearings, SEC hired a large room in the San Francisco Municipal Auditorium. When only witnesses, attorneys and newspapermen appeared, even on the second day, the sessions were shifted to the SEC offices in a downtown building.

Following the hearings before SEC Trial Examiner J. G. Clarkson, the application will be taken under advisement.

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Wisconsin Utilities Suffer Heavy Damages in Storm

Wisconsin utilities sustained heavy property damage as a result of a 60-mile gale which swept the state recently, accompanied by near-zero weather. Wisconsin Gas & Electric said that damage was over $50,000 and more than 200 employees labored day and night to restore service. All available material was used in making temporary repairs to poles, wires, etc., and seven carloads of material were ordered for permanent repairs.

Heavy losses were also suffered by Wisconsin Electric Power and Wisconsin Public Service.

In Indiana damage to utility property occurred during a severe storm.

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Sell More Appliances

Dealer sales of major appliances in the territory served by Virginia Public Service Co. continue to show expansion. During October electric range sales totaled 136, against 89 a year ago; refrigerators, 540, against 346, and water heaters, 37, against 36. For the first ten months range sales totaled 1,493, against 982 in the same 1939 period; refrigerators, 11,790, against 7,949, and water heaters, 517, against 381.

NEWS BRIEFS

THIRTY WATCHMEN have been appointed special police officers by Fort Wayne, Ind., board of public safety to guard plants of City Light & Power Co. and General Electric's two plants in the city. The men will be in uniform.

PICTURES of the first National Adequate Wiring Conference in the November 23 issue of ELECTRICAL WORLD were by Dick Osgood, Okonite Co.

HOW WAR ORDERS affect utilities is seen in the 25 per cent increase in power output of Detroit Edison last week.

NORTH CAROLINA WORKMEN joined with those imported from Utah to drive out the New York "Yankees" last week as rioting halted construction of the $6,500,000 power project of Nantahala Power & Light Co., subsidiary of Aluminum Co. of America. Fists flew as Governor Hoey called out police to quell the fighting. The issue—to make more employment for natives.

OF QUESTIONABLE VALUE as a defense measure, was the verdict of Gov. L. D. Barrows of Maine in commenting on the St. Lawrence project at the recent New England Conference in Boston, which was attended by 800 industrial and business leaders from all parts of the northeast.

FALL FESTIVALS have been held in celebration of many and various events, but the one the people of Plain staged in Sauk County, Wis., on that chill second Thursday in November is all the more unique. It was to celebrate the second anniversary of central station electric service or the second anniversary of the demise of the municipally owned power system. Michael A. Ring, president of Plain for the past seventeen years, said that the people of the town and outlying farms were satisfied with the change. Plain is served by Wisconsin Power & Light.

ELECTRICITY may replace chemicals in photography, with a permanent print obtained almost instantly, if wide use is made of the new method of Chester F. Carlson of Jackson Heights, L. I. The patent is 2,221,776.

NEW YORK'S CONSOLIDATED EDISON ran page ads last week to tell manufacturers and business customers of the new co-operative financing plan for purchase and installation of any appliance or equipment operated by electricity or gas. Terms are up to three years at low charges.

CLIFFORD E. HALL, publicity assistant to C. J. Allen, director of public relations of Connecticut Light & Power Co., is the author of a newspaper article included in "Headlining America," recently published collection of the 100 best stories of 1938 and 1939. He was with the Waterbury "American" until January, 1940.

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Plans to Discontinue Sales of Appliances

Effective January 1, Puget Sound Power & Light Co. is discontinuing the sale of electrical equipment outside of the Seattle area. This is in line with the company's policy of turning electrical appliance and equipment sales over to dealers whenever customer acceptance warrants and wherever competitive conditions permit.

Puget Power, according to Frank McLaughlin, president, will continue to supply advisory home, commercial, industrial, farm electrification and dealer co-operative services for the benefit of customers and dealers.

Mr. McLaughlin declared that "new low Puget Power rates, plus the ability of dealers in our operating area in marketing electrical appliances, combine to see to it that our mutual customers obtain the most for their electrical dollar."

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Wisconsin Utility Orders Boiler, Turbo-Generator

Wisconsin Public Service Corp. has placed an order for a Babcock & Wilcox boiler capable of delivering 312,000 lb. of steam per hour at a pressure of 650 lb. and 900 deg., according to A. G. Carson, chief engineer.

An order has been placed with Allis-Chalmers for a 30,000-kw. turbo-generator at 85 per cent power factor. The unit is for the Bayside plant and will be in operation by March, 1942.

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Dismisses Accounts Case

Federal Power Commission has dismissed the show cause proceeding instituted on July 14, 1939, against the Carolina Aluminum Co. because of the company's failure to comply with Electric Plant Accounts Instruction 2-D of the commission's Uniform System of Accounts, which requires a reclassification of accounts and the filing of data on original cost of electric plant. The company has now completed its reclassification and has filed the required data with the commission in compliance with its accounting requirements.

Public Relations Aired by Pacific Coast Group

Electrical association features Pasadena meeting with panel session for open discussions — Defines trend in automatic reclosing of oil circuit breakers

Panel discussions of public relations will probably be the most remembered features of the 1940 fall conclaves of the Pacific Coast Electrical Association. The second of these was held last week, when the association held its southern section meeting in Pasadena. This followed by one week the northern meeting in Oakland and attracted more than 450 members of the industry.

Public Relations

Combining the best features of an "Information Please" program and a conference, the public relations panels were effective in holding the attention of large audiences and served to stimulate thinking on many phases of the complicated public relations problem.

In each case the panel consisted of eight to ten men in executive and personnel capacities, drawn largely from outside the electrical industry. Presiding over the southern panel was S. E. Gates of General Electric Co., Los Angeles. George Tenney, editor of *Electrical West*, had presided at the northern panel.

Members of the operating economic section's transmission and distribution group defined a trend in automatic reclosing of oil circuit breakers as being toward reduced interval between shots and toward smaller numbers of shots. F. R. George, Pacific Gas & Electric, said discussions now are usually as to whether the number of shots shall be one or two, and that one shot, immediately reclosing, has been specified for recently installed zone type urban substations. It was mentioned that operation is now almost entirely from battery source.

A discussion of regulation dealt not only with regulators but also with the advantages of capacitors for regulating purposes, and some interest was displayed in the possibilities of series units, of which there are only a very few installations in the West. One system defined its objective in regulation as 117.5 to 120 volts at the meter for first class service, 116 to 121 volts for good service. Members of the meter group are finding that obsolescence of units originally purchased in the 1914-26 era is a subject of rising importance. Steam and hydro men met in small groups for unprogrammed, across-the-table discussions of their troubles.

Fluorescent Lighting

In the business development section fluorescent lighting held the spotlight and viewpoints of the manufacturer and of the utility were presented by spokesmen for the two. In the north, the week before, a report had been presented showing that stress on the economy of fluorescent light was leading not only to reduction in connected load but also to actual reduction in lumen output. Southerners doubted this for their area and pointed out that, from the revenue standpoint, longer burning hours for the fluorescent installations was a mitigating factor.

In addition to the big names attracted to the public relations panel, prominent speakers addressed various groups at the conclave. Dr. R. W. Sorensen, California Tech, national president of the American Institute of Electrical Engineers, addressed the operating economics section. His was an appeal for engineers to improve their technics for interchange of information so that benefits of the engineering method may be understood by the lay public and put to use in other fields.

J. O. Holbrook, assistant general sales manager the Paraffine Companies, outlined for members of the business development section a method of budgeting wherein a definite increment of net profit can be predicted and attained, regardless of the size of the business or the conditions under which it labors.

"America Straight Ahead" was the subject on which James Mussatti, general manager of the California State Chamber of Commerce, addressed one of the luncheon meetings of the membership at large.

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Central Maine Power to Start 27,000-Hp. Station

Central Maine Power Co. will proceed at once with the construction of a new steam-electric generating plant of approximately 27,000 hp. capacity, according to Walter S. Wyman, president of this utility.

Mr. Wyman said that the plant will consist of one 27,000-hp. steam turbine which is designed to operate at 600 lb. steam pressure and about 750 deg. superheat. The turbine, boilers and condenser were ordered last July, with the idea that they might be installed in 1941 if the rate of growth of the company's load seemed to indicate the need of more power capacity.

CONCLAVE—Seen during the Pacific Coast Electrical Association meeting (l. to r.) Stanley Scarl, General Electric; R. R. Walbridge, Southern California Edison, and Ad Long, Pacific Gas & Electric. Right is the public relations panel of (l. to r.) R. E. Fisher, Pacific Gas & Electric; Almon E. Roth, president of Employers' Council, San Francisco; G. C. Tenney, *Electrical West*, panel chairman; R. A. Balzari, sales councilor; Dr. Paul Eliel, Stanford University; Charles E. Dostal, Westinghouse, and Rilea W. Doe, Safeway Stores

Virginia Public Service Adds 15,000 Kw. Capacity

President O'Connell says territory is assured of future power needs by new unit placed in service and order for another 15,000-kw. unit to be installed in 1942

Adequate electric power for the present and future needs of northern Virginia was assured by M. J. O'Connell, president of Virginia Public Service Co., who announced this week that the $2,000,000 addition to the Alexandria generating station, with an added capacity of 15,000 kw., is now in operation and that the construction of another 15,000-kw. unit, also costing approximately $2,000,000, has been approved by directors.

Simultaneously it was announced that the Virginia Electric & Power Co. plans to change its Richmond to Occoquan line from 66 kv. to 110 kv. and that Virginia Public Service will likewise change its line from Alexandria to Occoquan from 66 kv. to 110 kv. The effect of these changes will provide an interconnection capable of delivering from 15,000 to 20,000 kw. from this source alone.

Mr. O'Connell said that the plans of the company are in line with the policy of anticipating power needs so that availability of power is well ahead of demands.

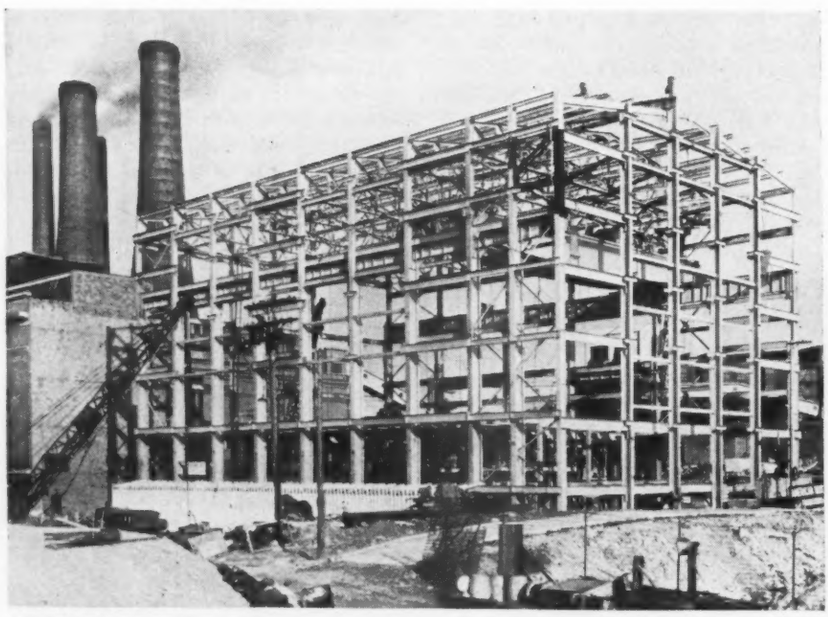
The new unit at Alexandria more than doubles the capacity. The decision to make still another addition, Mr. O'Connell said, is due to the company's desire to be prepared for any sudden demands that might arise in the next few years. Delivery of the new unit is assured within fifteen months because Westinghouse Electric & Manufacturing Co. had already begun the manufacture of a unit similar to the one required, Mr. O'Connell declared. Completion of the proposed addition is expected early in 1942.

Plenty of Power

In support of his statement that ample power is now available, Mr. O'Connell stated that the peak demand for Arlington and Alexandria is approximately 23,000 kw. With 29,250 kw. rated capacity available at the Alexandria station, approximately 10,000 kw. at the interconnection with the company's Bremo Bluff station and a potential capacity from 15,000 to 20,000 kw. which will be available at the interconnection with Virginia Electric & Power system at Occoquan, more than double the peak demand of the present load will be available.

The need for additional generating facilities has been occasioned by the unprecedented growth of northern Virginia and the recently accentuated national defense activities in the capital area. Mr. O'Connell pointed to the 112 per cent increase in population in Arlington County since 1930 and a 40 per cent increase in Alexandria. The company has kept pace with this growth by rebuilding the distribution system of Arlington County by increasing capacity of substations, by perfecting interconnections with the company's generating and transmission facilities in other parts of the state and with those of Virginia Electric & Power, and by increasing generating capacity.

The latest demands on the company's power facilities on a large scale have been the Naval Torpedo Station at Alexandria, Fort Belvoir, and the Washington National Airport. The first federal office building outside of the District, which is to be erected in Arlington County near Fort Myer, as well as other projects, will bring about additional demands for power.



NEW ADDITION—Construction work is moving rapidly ahead at the Lake Shore power plant of Cleveland Electric Illuminating Co., where the company is building an addition to house 240,000 kw. The addition, one 60,000-kw. General Electric unit and two Babcock & Wilcox boilers, will cost $6,300,000 and be completed in 1941. Another 60,000-kw. unit has been ordered for delivery in 1942 at a cost of $1,900,000

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B. C. Commission Issues First Annual Report

In its first year of operation the British Columbia Public Utilities Commission dealt with thirteen applications for lower water and electricity rates, according to the first annual report of the commission tabled in the Legislature. In three cases adjustments were made and rates revised to meet minor local conditions. Some applications were later dropped or not disposed of within the year, the commission reported. B. C. Electric Railway Co. investigation has not been completed.

The commission reports the filing of rate schedules by 138 companies, gives 21 applications approved for issues of securities and mortgages by utilities and 20 applications for extensions of service systems.

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Boulder Plant Contracts

Bureau of Reclamation, Denver, Colo., has awarded a contract to General Electric Co. at $411,099 for three transformers and three oil circuit breakers for generating unit A-5 at Boulder power plant, Boulder Canyon project. Award was also made to Graybar Electric Co. at $46,549 for six disconnecting switches for same generating unit (Specifications 928).

FBI Makes Inquiry to Prevent Sabotage

Newspaper headlines notwithstanding, there is no wave of sabotage sweeping the country. The normal number of industrial accidents and fires are occurring, but recent sensational explosions and other mishaps have been reliably cleared of deliberate origin.

Despite this, the Federal Bureau of Investigation is continuing its steady, long-defined policy of precautionary work directed at protecting manufacturing plants and utilities against outrages. Already FBI has nearly completed formal, detailed studies of more than 1,000 plants which the Army and Navy asked to have inspected. It also is busy making other surveys for plants with defense orders which ask that advisory, non-compulsory surveys be made.

The FBI's handbook for sabotage protective measures is essentially a program of watertight details, looking out beforehand for the little things. Its broad recommendations are relatively simple.

First step recommended by FBI in studying a utility or plant for protective measures is determination of danger points—locations or processes which, if damaged, could cripple all operations. Such points should be carefully mapped and the details kept, with all other confidential material, in an isolated, guarded special section of the property accessible only to specified employees with legitimate business there.

While fencing and illumination are considered the main physical protective needs, special care is recommended to finding irregular entrances such as sewers, fire escapes, etc.

Personnel control begins with obtaining complete data about each man, new as well as old employees.

FBI recommends that the reason for all absences from work be checked, that absence without legitimate excuse be grounds for suspicion, particularly if an employee leaves town secretly.

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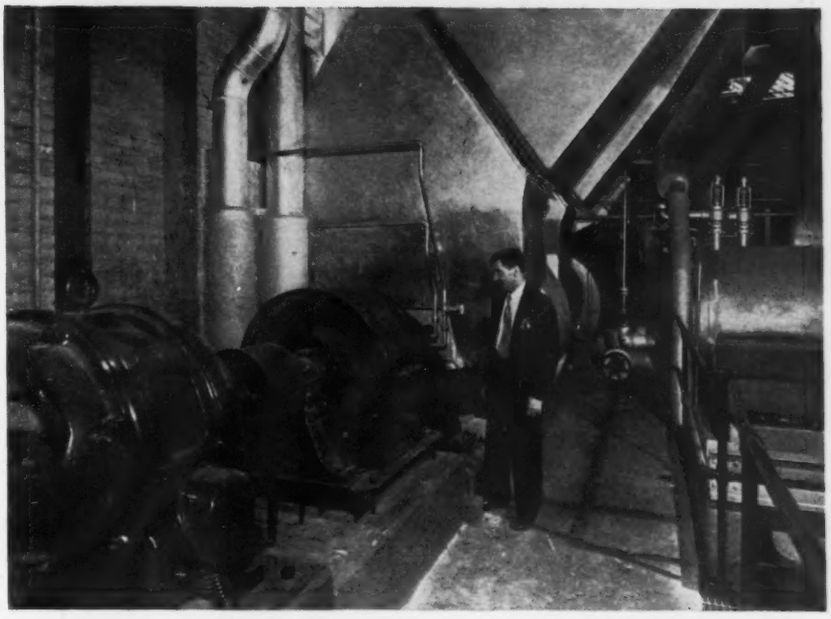
Associated Gas Group Asks Investor Protection

An appeal to the various federal and state public utility rate and security regulatory bodies not to "sacrifice" investors in their effort to "protect" consumers has been made by the general protective committee of Associated Gas & Electric Co. in a report to security holders.

Copies of the report, with the pertinent portions marked, were sent to the SEC, the Federal Power Commission and to the commissions concerned in the twenty states in which the Associated System operates.



INSPECTION—A. J. Monnen, assistant to the plant superintendent, Savannah (Ga.) Electric & Power Co., inspects a new magnetic variable-speed drive operating an induced-draft fan for the boiler unit recently installed at the Riverside station. Stone & Webster Engineering Corp. designed and constructed the new plant addition

The committee said that the "gamblers, as distinguished from the investors, are responsible for what has occurred. Efforts to protect the consumers should not sacrifice the investors, whose money was utilized to furnish consumer facilities."

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Executive Changes Made by N. Y. Utility

At a meeting of the board of trustees of Consolidated Edison Co. this week numerous changes in the organization were made to bring about further combination of electric and gas operations of the company. Howard W. Leitch, vice-president in charge of electric operations, and William C. Morris, vice-president in charge of gas operations, who have passed the company's retirement age, were relieved of administrative duties. They will act hereafter as consultants on special assignments from the president.

Three new vice-presidents were elected. Hudson R. Searing, engineer of operation in the electric field, became vice-president in charge of electric and gas operation and electric production. James F. Hunter, assistant vice-president, became vice-president in charge of technical service and gas production. Leland B. Bonnett, engineer, design and planning, became vice-president in charge of design, inventory, purchasing and stores.

Six new assistant vice-presidents were elected: Harland C. Forbes, system engineer in the electric field, was made assistant vice-president for research, development and planning. Porter C. Savage, purchasing agent, and James F. Fairman, electrical engineer, became assistant vice-presidents for design, inventory, purchasing and stores. George L. Knight, engineer of construction and vice-president of Brooklyn Edison Co., and Earl L. Griffith, engineer of gas maintenance and construction, were made assistant vice-presidents for construction and shops, and Colin C. Simpson, engineer of gas distribution, became assistant vice-president, operation and electric production. These changes become effective December 1.

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Plant Nears Completion

The new $600,000 hydro-electric power plant of the municipal utility at Kaukauna, Wis., is expected to be completed by December 15, according to H. F. Weckwerth, general manager of the plant. When completed the plant will have a 2,400-kw. generator and provisions for another generator with a 3,200 kw. capacity.

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Newspaper Gets Award

Louisiana Power & Light Co. employees' publication, "Safety Service," has won first place in its class in the 1940 employees' magazine contest, conducted by the employees' publication section of the National Safety Council.

Power Show to Open in New York Dec. 2-7

Exhibitors at the 14th National Exposition of Power and Mechanical Engineering, to be held in New York December 2–7, accent heavily the means for stepping up existing power plants to carry tremendous additional loads in meeting the demands resulting from the national defense program.

Emphasis is on the economics of power production and utilization, rather than the question of supply, and the Power Show is to reveal the new techniques that are constantly being developed in the power field. Improvements in major and minor equipment items are to be shown by manufacturers.

Nearly 300 exhibits will reveal the progress in the power field, with a large number of displays reflecting manifold advances.

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Engineers Shortage Seen by Next Summer

National defense through engineering training was the theme of the gathering at Boston last week to take part in the inauguration of former dean of engineering Carl S. Ell as president of Northeastern University, successor to Frank Palmer Speare.

President H. N. Davis of Stevens Institute of Technology said that by next summer a serious shortage of engineers impends. The engineering schools, he pointed out, must continue with their regular work and avoid turning out half-trained graduates. Undergraduates should be given deferred ratings under the selective draft until they have finished their normal engineering training.

The transfer of qualified undergraduates in arts colleges to advanced standing in the engineering schools, the giving of "refresher courses" to graduates and near-graduates now unemployed or in non-essential occupations and short courses in engineering for certain arts college graduates who have majored in exact sciences were suggested as contributions to the program for defense industry training.

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Nantahala Power & Light Orders G. E. Equipment

Electric equipment for new hydro-electric power stations to be located at Nantahala and Glenville, N. C., has been ordered by Nantahala Power & Light Co. from General Electric Co. The G.E. equipment consists of two 27,000-kva., 150,000-volt, three-phase transformers and a 54,000-kva. vertical waterwheel driven generator, together with a motor-generator exciter set. Four G.E. 9,000-kva., 150,000-volt, single-phase transformers are to be installed at the Glenville station. Glenville station will be ready for operation late in 1941 and the Nantahala station the following year.

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Board Sets Rate Hearing

Maryland Public Service Commission has set December 17 as the time for opening a public hearing in regard to the furnishing of electrical energy and the rates charged by the Susquehanna Power Co. and the Susquehanna Electric Co. to the Conowingo Power Co.

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Utility Resumes Selling

Menominee & Marinette Light & Traction Co., operating in Menominee, Mich., and Marinette, Wis., after a year of experimentation with dealers as the sole outlet for gas and electrical appliances, has returned to the merchandising of ranges, water heaters, small electrical appliances, I.E.S. lamps and lighting modernization equipment. The company said that dealers failed to produce the business anticipated.

MEETINGS

Edison Electric Institute—Fourth National Accounting Conference of accounting committees of Institute and American Gas Association, Book-Cadillac Hotel, Detroit, Mich., December 2-4. Prime movers committee, New York Headquarters, 420 Lexington Av., December 2-3.

American Society of Mechanical Engineers—Annual meeting, New York, N. Y., December 2-5. C. E. Davies, national secretary, 29 West 39th St., New York, N. Y.

American Society of Agricultural Engineers—Fall meeting, Chicago, Ill., December 2-6.

National Exposition of Power and Mechanical Engineering—Grand Central Palace, New York, N. Y., December 2-7.

American Society of Refrigerating Engineers—Annual meeting, Hotel Commodore, New York, N. Y., December 4-6.

National Association of Railroad and Utilities Commissioners—Annual convention, Hotel Miami-Biltmore, Miami, Fla., December 10-12. Clyde S. Bailey, secretary, New Post Office Bldg., Washington, D. C.

National Chemical Exposition — Sponsored by Chicago Section, American Chemical Society, Stevens Hotel, Chicago, December 11-15.

Petroleum Electric Power Association — Annual conference, Hotel Heidelberg, Baton Rouge, La., December 12-13. G. H. Weckel, secretary, Kansas Gas & Electric Co., Wichita, Kans., and James Hodge, Gulf States Utilities Co., Baton Rouge, La.

American Association for the Advancement of Science—Bellevue-Stratford Hotel, Philadelphia, Pa., December 27-January 2.

Canadian Electrical Association — Annual winter conference of association committees, Montreal, Que., January 20-21. B. B. Fairchild, secretary, 804 Tramways Bldg., 159 Craig St., West, Montreal.

American Institute of Electrical Engineers—Winter convention, Philadelphia, Pa., January 27-31. H. H. Henline, national secretary, 33 West 39th St., New York, N. Y.

Sees Utilities Ready to Meet Emergency

Public utilities are better equipped today to meet such an emergency as invasion would bring than they were prior to the World War, Dr. Marvin L. Fair, professor of economics at Temple University, told the annual convention of the New Jersey Utilities Association in Atlantic City last week.

Dr. Fair said that there must be the closest co-operation between state and federal regulatory bodies and that rate adjustments should be far more prompt than in the early months of the last war.

John A. Riggins, president of the association, said that "real economic planning leads inevitably to autocracy and dictatorship.

"We already have more than 200 bureaus, departments and commissions under executive control, regulating our lives in one way or another. If economic planning is allowed to multiply it will add to the already enormous expansion of the scope of government, which is bound to crush freedom by sheer weight."

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Niagara Celebrates 50 Years of Power

Throughout the Niagara Frontier the 50th anniversary of the development of hydro-electric power at Niagara Falls is being celebrated. It was on October 4, 1890, that ground was broken for the gigantic discharge tunnel beneath the town of Niagara Falls.

Factories were to draw water from the upper Niagara River by small canals and, after using it to turn waterwheels and turbines, generating electricity for their own need, discharge the water into the tunnel.

The company became known as the Niagara Falls Power Co., now a major unit in the Niagara Hudson Power system. It was the decision to retain the tunnel plan evolved by Thomas Evershed, but to generate electricity at one central station. On November 10, 1896, Buffalo, 20 miles away, received power from Niagara Falls, and this proclaimed that power could be carried over what was considered then long distances.

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P.G.&E. Tie Lines

Pacific Gas & Electric will soon start work on the installation of additional tie lines to provide a more efficient power distribution service in the Petaluma area. The project represents a $200,000 investment.

Output Dips 2% in Thanksgiving Week

The Thanksgiving holiday was reflected in the lowered electricity production in the week ended November 23, when the energy output by the electric light and power industry amounted to 2,695,431,000 kw.-hr., a gain of 8.6 per cent over the corresponding week of last year, according to the Edison Electric Institute.

Output of electricity in the most recent week was 23.4 per cent higher than in the corresponding week of 1938 and 30.5 per cent above the similar week of 1937, the previous high output year. For the week ended November 23 energy production was 2.0 per cent above last winter's peak; corresponding increase a year ago was 5.0 per cent.

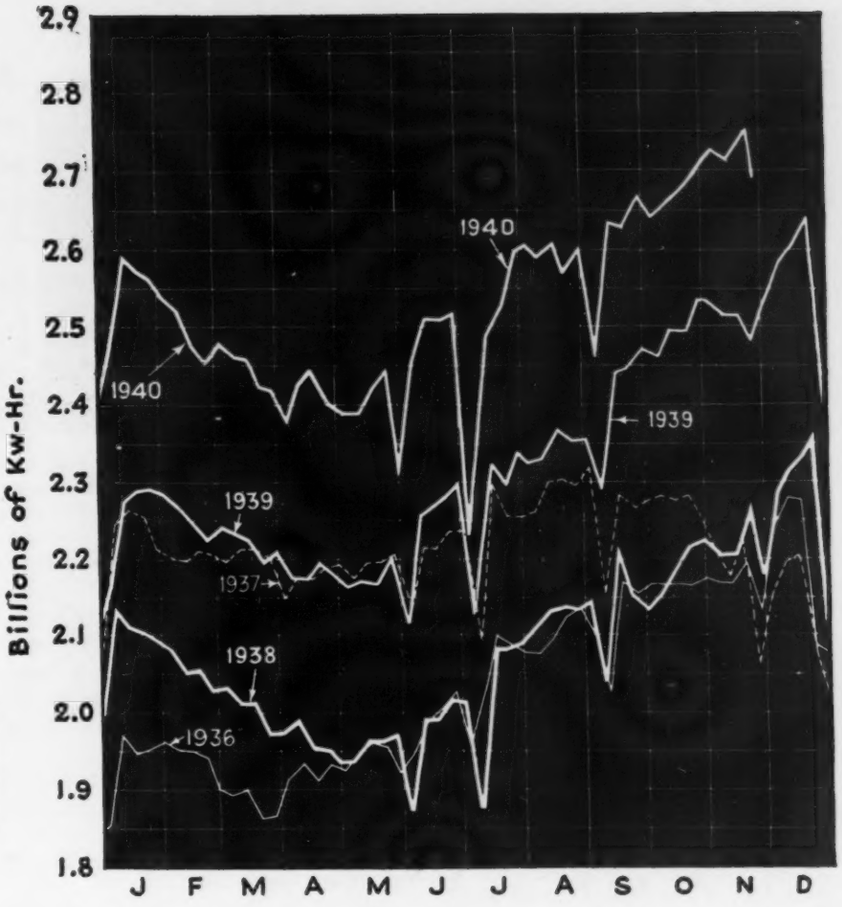
All of the major geographic regions except the New England and Pacific areas reflected the lower output in decreased percentage gains over 1939 in the most recent week. The New England area—where Thanksgiving was celebrated this week—rose from 3.6 per cent in the previous week to 4.9 per cent. The rise for the Pacific Coast area, from 3.8 to 7.1 per cent, is probably attributable in part, at least, to increased activity at aircraft plants.

Weekly Output, Millions Kw.Hr.

1940		1939		1937	
Nov. 23	2,695	Nov. 25	2,482	Nov. 27	2,065
Nov. 16	2,752	Nov. 18	2,514	Nov. 20	2,224
Nov. 9	2,720	Nov. 11	2,514	Nov. 13	2,177
Nov. 2	2,734	Nov. 4	2,537	Nov. 6	2,202
Oct. 26	2,711	Oct. 28	2,539	Oct. 30	2,255
Oct. 19	2,687	Oct. 21	2,494	Oct. 23	2,282
Oct. 12	2,665	Oct. 14	2,495	Oct. 16	2,276
Oct. 5	2,641	Oct. 7	2,465	Oct. 9	2,280
Sept. 28	2,670	Sept. 30	2,470	Oct. 2	2,276

Per cent Change from Previous Year

	Week Ending		
	Nov. 23	Nov. 16	Nov. 9
New England	+ 4.9	+ 3.6	+ 5.5
Middle Atlantic	+ 7.8	+ 9.6	+ 6.5
Central Industrial	+ 9.7	+13.2	+10.6
West Central	+ 6.2	+ 6.3	+ 5.4
Southern States	+ 9.0	+ 9.6	+ 9.2
Rocky Mountain	+ 3.8	+ 4.3	+ 2.2
Pacific	+ 7.1	+ 3.8	+ 4.5
United States	+ 8.6	+ 9.4	+ 8.2



Pacific Coast Utility to Build New Hydro

Work will soon be started by Pacific Gas & Electric Co. on a new $3,210,000 hydro-electric generating plant near Dutch Flat on the Bear River in Nevada County.

P. M. Downing, vice-president and general manager, said that roads already have been laid out and camp sites picked for the various units of the two-year job.

The new plant, first unit to be undertaken for providing additional power needs for 1943, will have a capacity of 28,000 hp.

Transmission lines to connect it with the existing system will add $570,000 to the cost.

A 4-mile tunnel to bring water to the new plant from the after-bay of the Drum plant on the Bear River will be the first job.

Mr. Downing said that the anticipated load growth of 1941 and 1942 will be taken care of through the completion of three new steam-generating plants located at oil refineries in Contra Costa County and by arrangements recently made for purchases of an additional 65,000 kw. from Southern California Edison Co., which will be taken into the system at substations at Piedra in Fresno County and Magunden in Kern County.

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PUD Signs Contract for Columbia Power

Grays Harbor County (Wash.) Public Utility District No. 1 has contracted for the purchase of 2,000 kw. of prime and additional amounts of surplus power being generated by the federal government on the Columbia River at Bonneville and Grand Coulee dams.

The twenty-year contract, signed in Aberdeen, Wash., calls for the immediate delivery of the prime power to the district's distribution system at Cosmopolis, on the outskirts of Aberdeen. The district will make a substantial reduction in retail rates to be effective with the billings on January 1, 1941. It has agreed to adopt as an objective, the Standard Resale Rate Schedule recommended by the Power Administration for public agencies using Columbia River power.

The district will pay the federal government $17.50 a year for each kilowatt of capacity covered in the contract and ¼ cent per kilowatt-hour for surplus power. The district has agreed to purchase up to $10,000 worth of surplus energy annually if such energy is available. Power deliveries will be made over a transmission line acquired last year from the Willapa Electric Co. by the Power Administration.

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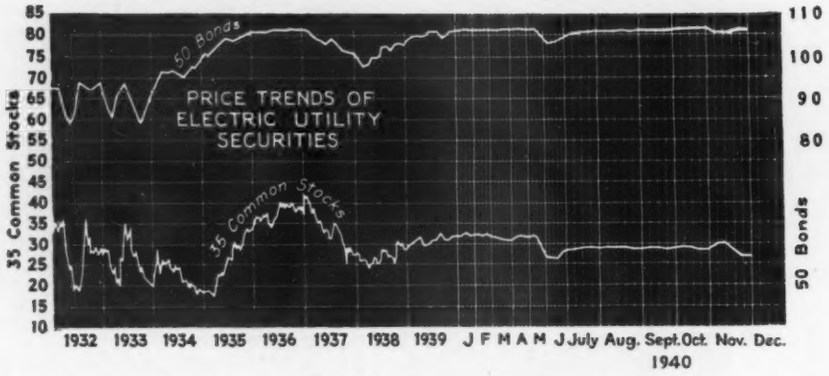
Ontario Primary Load Up

Hydro-Electric Power Commission of Ontario reports primary load for all systems in October at 1,783,962 hp., against 1,669,337 hp. in October, 1939, an increase of 6.9 per cent.

Utility Stocks Lower; Bonds Hold Ground


50 Bonds
PRICE TRENDS OF ELECTRIC UTILITY SECURITIES
35 Common Stocks
35 Common Stocks
50 Bonds
85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10
110 100 90 80
1932 1933 1934 1935 1936 1937 1938 1939 J F M A M J July Aug. Sept. Oct. Nov. Dec. 1940

Electric light and power stock prices continued the downward trend of the past few weeks. "Electrical World" stock index dipped to 27.0; last week, 27.6; last year, 31.7. Bond index remained unchanged at 106.2; last year, 106.1

Indianapolis Stock Marketed at $107.50

Public offering was made this week of 140,591 shares of Indianapolis Power & Light Co. 5¼ per cent cumulative preferred stock of $100 par value. The offering, at $107.50 a share, is to be made subject to an exchange offer to holders of all outstanding 6½ per cent and 6 per cent cumulative preferred shares.

These holders of 115,777 shares of 6½ per cent and 24,814 shares of 6 per cent preferred stock are to be offered one share of new 5¼ per cent preferred for each share of preferred held, plus cash of $4.125 for each 6½ per cent share and $4 for each 6 per cent share held. The cash amount is equal to the excess of the redemption price a share of the outstanding preferred (including accrued dividends) over the offering price of the new 5¼ per cent preferred.

Net proceeds from the sale of the 5¼ per cent stock, together with treasury funds, will be used to redeem all the 6½ and 6 per cent preferred stocks at $110 a share, plus accrued dividends to January 1, 1941, the redemption date.

•

Financing Postponed by Danbury Utility

Public offering of bonds, preferred and common stock of the Danbury & Bethel Gas & Electric Co., originally planned to be made last week, has been indefinitely postponed as a result of action of advocates of municipal ownership to have the township of Danbury acquire the utility, now a unit in the Cities Service Power & Light Co. system.

The underwriting syndicate has withdrawn from the contract for the sale of $720,000 of 3 per cent general mortgage bonds, due 1970, of 9,600 shares of 4½ per cent preferred stock of $50 par value and of 144,000 shares of $5 common stock.

This financing was to have been a dual operation of refunding 7 per cent preferred and 6 per cent bonds and of disposition of Cities Service Power & Light's ownership of 100 per cent of Danbury & Bethel Gas & Electric's common.

Sale of the securities has already been approved by the Connecticut Public Utilities Commission and the Securities and Exchange Commission.

•

Submits $37,000,000 Refunding Plan

A plan indorsed by the trustees of Associated Gas & Electric Corp. for refunding obligations of the Virginia Public Service Co., one of that system's major operating properties, by private sale of $36,500,000 of bonds and notes has been submitted to the SEC for consideration.

Proposal provides for sale by Virginia Public Service Co. of $28,000,000 of 3¾ per cent first mortgage bonds, due 1970, and of $8,500,000 of 3 per cent and 4 per cent notes, maturing serially within from 2½ to fifteen years. Proceeds from sale of these securities to five insurance companies and a bank would be used to redeem $35,981,500 of 4, 5, 5½ and 6 per cent bonds, notes and debentures and to pay about $785,000 in premiums on some of these obligations.

Virginia Public Service also notified the SEC that it proposed to merge its following wholly owned subsidiaries, Virginia Public Service Generating Co., Hampton Towing Corp., Harpers Ferry Paper Co. and Middle Virginia Power Co.

At a public hearing before the Virginia Corporation Commission C. M. Chichester, special assistant attorney-general, questioned the advisability of the plan. In his testimony before the board M. J. O'Connell, president of the utility, stated the company's customers grew by 31 per cent in the past three years, and that during the same period total electric production jumped from 233,000,000 to 330,000,000 kw.-hr.

•

Appalachian Files $70,000,000 Issue

Appalachian Electric Power Co., a subsidiary of the American Gas & Electric Co., has filed with the SEC a registration statement covering issuance of $70,000,000 of first mortgage bonds due in 1970 and 300,000 shares of cumulative preferred stock of $100 par value.

A joint application also was filed under the Holding Company Act by Appalachian Electric, American Gas & Electric and the Peakland Corp.

Appalachian Electric proposes to offer to holders of its outstanding $6 and $7 preferred stocks, other than American Gas and Peakland, the privilege of exchanging the stock for the new preferred on a share-for-share basis plus cash equal to the difference between the redemption price of the outstanding preferred stock and the initial public offering price of the new preferred. Shares not taken under the exchange offer will be offered publicly.

Proceeds are to be used for refunding purposes.

•

Distribute Stock Pro Rata

Beauharnois Power Corp., Ltd., announces that incidental to the winding up of the company the only asset of the corporation (capital stock of the subsidiary, Beauharnois Light, Heat & Power Co.) is being distributed on a pro rata basis among its shareholders.

Utility Reports

	Net Income 1940	1939
*Associated Electric and subs.	$2,087,285	$2,322,060
†Detroit Edison and subs.	10,294,076	9,986,091
*NY PA NJ Utilities and subs.	6,300,831	5,003,947
*Pacific Gas & Electric	25,397,443	25,633,593
†Public Service Corp. of N. J. and subs.	23,221,694	26,039,550
*Standard Gas & Electric and subs.	4,056,859	2,647,157

*Twelve months ended September 30.
†Twelve months ended October 31.

OPERATING PRACTICES

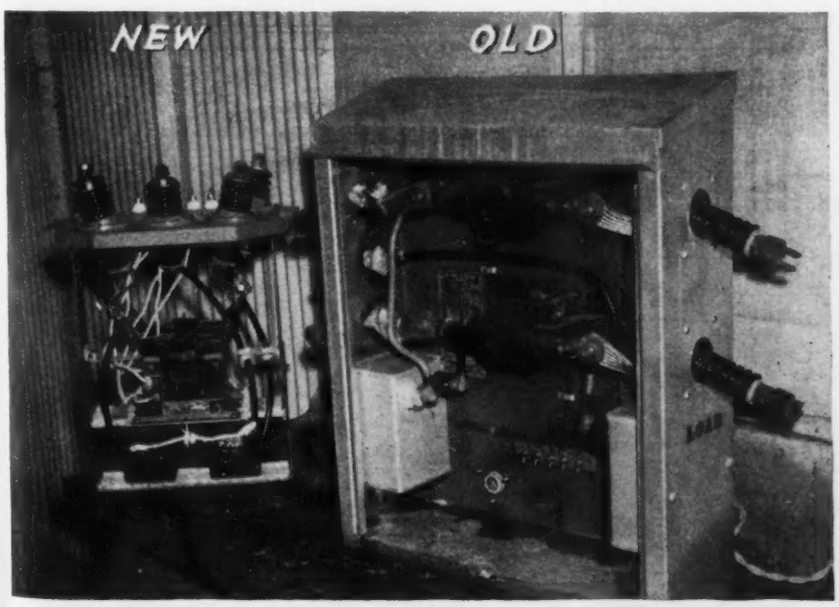
Oil Immersion Solves Insulation Problem

A combination of atmospheric conditions traceable to the oil fields and to iodine concentrations in sea breezes along the Gulf Coast in the vicinity of Corpus Christi, Texas, has been blamed for deterioration of insulation on instrument transformers experienced until recently by the Central Power & Light Company. Until the company adopted the practice of operating all potential and current transformers oil-immersed an average of 60 failures of instrument transformer equipment was experienced each year; since use of oil-immersed equipment failures traceable to atmospheric conditions have dropped to zero.

Originally the company used indoor-type current and potential transformers in a special outdoor cabinet of the type shown in the accompanying illustration. In fact, at one time the bushings shown on the outdoor housing were omitted. The bushings were added when it was found that water ran down the cable leads to the potential transformer and resulted in failure; bushings and a drip loop solved this problem, but did not correct the continuing troubles with insulation failure.

The instrument transformer housing that is being used at present consists of a 24x16½-in. sheet-metal tank, filled with transil oil, into which the potential and current transformers are inserted. The transformers are mounted on a rack that is bolted to the tank cover into which the bushings are built.

Numbers on the secondary terminals of the instrument transformer case correspond to markings on meter terminals in the weatherpoof meter box with which the transformers are used. With this arrangement it is possible for the lineman installing the equipment to connect it up, thus eliminating a trip for the meterman. It might be explained that wiring in the weatherproof meter box referred to is complete and the instruments are installed before the box is sent out for installation. The lineman merely mounts the meter box and the instrument transformer housing on the pole and connects the terminals of one to the terminals of the other with a cable riser.



IMMERSE instrument transformers in oil to stop insulation deterioration traced to atmospheric conditions along the Gulf Coast in the vicinity of oil fields. Picture clearly shows saving in space with oil-immersed housing over use of indoor transformers in weatherproof housing

New Type Rectifiers Save Space

By J. A. CHEVERTON
Station Engineer, Wisconsin Electric Power Company, Milwaukee, Wis.

Installation of a new 35,000-kw. turbo-generator, currently in progress at Commerce Street station of the Wisconsin Electric Power Company, Milwaukee, required removal, among other things, of two 2,000-kw., 600-volt street railway generators to provide the necessary space. New means of 600-volt supply to replace the old engines was necessary. Consideration of a number of alternatives finally led to the selection of the new single-anode type mercury-arc rectifiers principally because their compact design allowed a 3,000-kw. unit to be installed in an available space 15x24 ft. or in one-tenth the cubic space

ONE OF TWO 1,500 six-phase single-anode mercury-arc rectifiers installed at Commerce Street power plant to replace two 2,000-kw., 600-volt street railway generators

occupied by the displaced generators.

With the exception of the two generators at Commerce Street station the 600-volt street railway power in Milwaukee had been entirely supplied by rotary converters in scattered substations. It seemed logical, therefore, to install converters at the plant. However, space considerations ruled out any type of rotating equipment.

Mercury-arc rectifiers were next considered because of their advantages over rotating equipment of speed in starting, high efficiency over a wide local range, compactness, light weight, low maintenance and ability to carry high, short-time overloads. However, even a conventional multiple anode, single-tank mercury rectifier was found to bulk too large for the available space.

Recently introduced single-anode, ignition type rectifiers, differing from conventional units in that each anode has its individual tank, offered the compact design that the situation demanded.

Each of the two 1,500-kw. units installed has six single-phase tanks and is 8 ft. long, 45 in. wide and 65 in. high. Both units, therefore, fitted conveniently into the available 15x 24-ft. room under the substation gallery.

Although initial operation of the units was as separate six-phase rectifiers, they can be operated together as a single 3,000-kw., twelve-phase rectifier. Starting of the units is essentially instantaneous, and although the continuous rating is 3,000 kw., a load of 4,500 kw. can be carried for two hours and 9,000 kw. for one minute. Efficiencies over the load range from 25 per cent to 150 per cent vary from 95 per cent up to about 95.7 per cent at 75 per cent and down to 94.8 per cent at 150 per cent load.

The rectifier transformer is supplied from the 13,800-volt, three-phase, 60-cycle station bus. The operation of transformer, rectifier and auxiliaries is automatic except for starting and stopping. This operation is performed by means of a push-button station located in the switchboard room where the operator supervises the loading of feeders and generators. The rectifier is automatically protected from the time it starts to the time it shuts down.

Particular attention is directed to the fact that the two units installed at Commerce Street weigh 10,000 lb. together, compared with 66,000 lb. for a rotary converter of equal capacity. Space required by the two displaced 2,000-kw. generators was 85,000 cu.ft., whereas the rectifier units occupy 8,600 cu.ft.

•

Cable-Entrance Pole, 2,300-4,600 Volts

West Penn System has adopted the following distribution specifications for typical cable-entrance pole, 2,300-4,600 volts:

(a) 2,300-4,600-volt arrester, using 300-volt arrester in 4,000-volt neutral.

(b) 2,300-4,600 fuse cutout, using cutout as disconnect in 4,000-volt neutral.

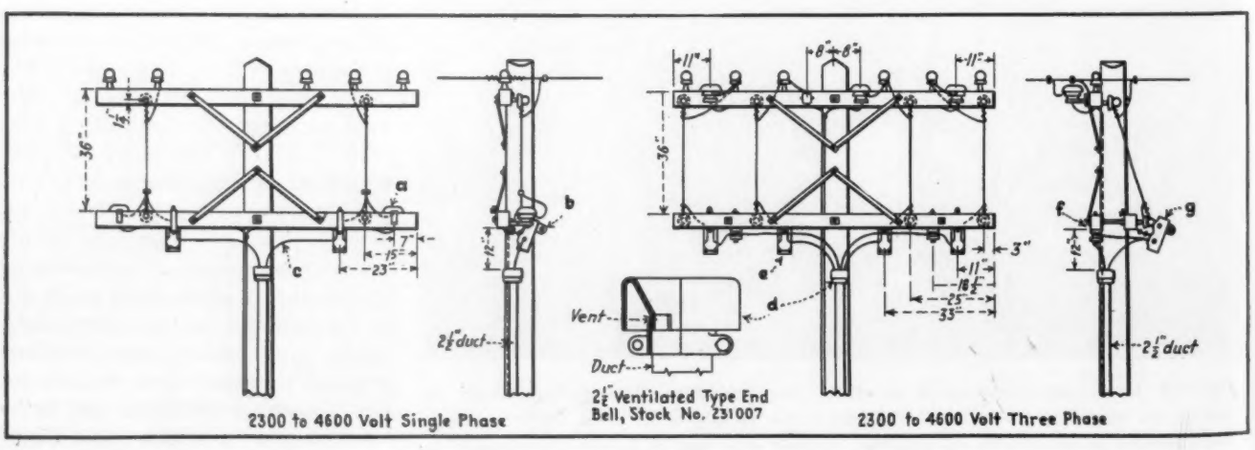
(c) Minimum radius of bend at end of duct ten times outside cable diameter size and class of cable will be specified on line plan.

(d) Place stuffing around cables at a point above vent and fill upper part of bell with insulating compound.

(e) Use cutout as disconnect in 4,000-volt neutral; omit cutout and use three-conductor cable for 2,300- or 4,600-volt lines.

(f) ½ x 10-in. machine bolt and spool insulator; tie cable to spool with marlin cord.

(g) 2,300-4,600 fuse cutout.



CABLE ENTRANCE pole design

SAVE 10% OR MORE

on Small, Outdoor, Reclosing Oil Circuit Breakers

By Purchasing Standard Equipments

WHAT YOU GET IN THESE BREAKERS—

1. A nonpumping, completely adjustable, three-shot reclosing breaker with dependable overcurrent relay protection.
2. Factory-assembled unit, entirely adjusted and ready for service.
3. Oil-blast principle of interruption for reliable circuit protection.
4. Silver-to-silver main contacts and heavy, butt-type arcing contacts—for long life, service continuity, and low upkeep costs.
5. Single, easily lowered oil tank, which facilitates routine inspections.

(Want more information? Write for descriptive bulletins GEA-2406A and GEA-2426B.)

NOW you can enjoy the protective advantages of *reclosing* oil-blast breakers at lower cost! We've *reduced prices* on standard units—WITH NO REDUCTION IN QUALITY.

A recent study indicates that 85 per cent of your requirements for breakers of this type can be met with *standard* equipments. This helps us to achieve certain engineering and manufacturing economies, which we are passing along to you in reduced prices.

What's more, these standard units are easier to select than nonstandard breakers with special auxiliaries. They're properly co-ordinated for better service and come to you completely assembled ready to be put into operation. Quicker deliveries, too, are now possible on these standard equipments.

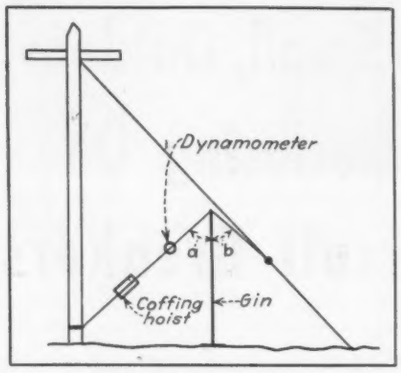
Ratings available: for 7500-volt service, the Type FKO-227 breaker, 50,000 kva interrupting rating, 400-600 amp; for 15,000-volt service, the Type FLO breaker, 50,000 kva to 250,000 kva interrupting rating, 600-1200 amp. Ask your G-E representative to demonstrate how these complete units will fit your needs. General Electric, Schenectady, N. Y.

ALL YOUR POWER GOES THROUGH YOUR SWITCHGEAR

GENERAL ELECTRIC

Anchor Guys Tested in Place

Several thousand dollars was recently saved by Nevada California Electric Corporation on a job which involved replacing guy anchors. The saving was made by avoiding the replacement of certain anchors through testing the strength of all anchors in place.



SCHEMATIC arrangement of gin pole and line used to put tension on anchor guy

This was done by means of the set-up shown in the sketch. It consists simply of a line supported at the center by a gin pole and fastened at one end to the butt of the power pole and at the other to the guy. In the line are a Coffin hoist for drawing up the tension and a dynamometer for measuring that tension.

The device is set up so that the line attached to the guy wire is parallel to it and so that the angle "*a*" equals angle "*b*." With this geometrical relationship existing, tensions in the two sides are equal and tension on the guy can thus be read on the other side of the gin pole, where it is more convenient to place the dynamometer.

Tension is drawn up until it is equal to that for which the anchor is designed. Obviously, if the anchor holds it does not need replacing.

The gin pole consists of a light piece of hardwood, with a foot which prevents its sinking in soft ground.

This device proved its usefulness on a 75-mile section of line where trouble had been encountered when anchor rods pulled out of old treated-wood anchors. The line involved 297 guy anchors, and it was proposed to replace the old wood anchors with new ones of concrete.

Estimated cost of replacing anchors on half the line was $3,000, and an expenditure in this amount was approved. However, by sending out a two-man crew to test the anchors with the equipment described above it was found that only 40 anchors of the entire 297 failed on test. Hence it was possible to recondition the entire line for less than the amount originally set aside for half the job.

The device was developed by R. L. Taylor, the corporation's superintendent of transmission, and the work was undertaken under his direction.

•

Wire Mesh Makes Good Meter Rack

Meter racks in the meter room of the Central New York Power Corporation, Syracuse, N. Y., have been built of wire mesh panels mounted on pipe. The meters are hung by simple S-hooks. Each panel is 60 in. wide by 72 in. high consisting of No. 8 wire on 1½-in. square mesh attached on 45 deg. bias to a metal framework which is mounted on 1¼-in. pipe standards having floor flanges at floor and ceiling. Such a panel readily handles seven rows of nine single-phase meters on each side. The grille makes it easy to change the spacing for polyphase and other meters larger than the single-phase sizes.

The bottom of the panel is kept 1 ft. above the floor. Aisles between panels are made 50 in. wide so as to accommodate a truck for direct loading and unloading.

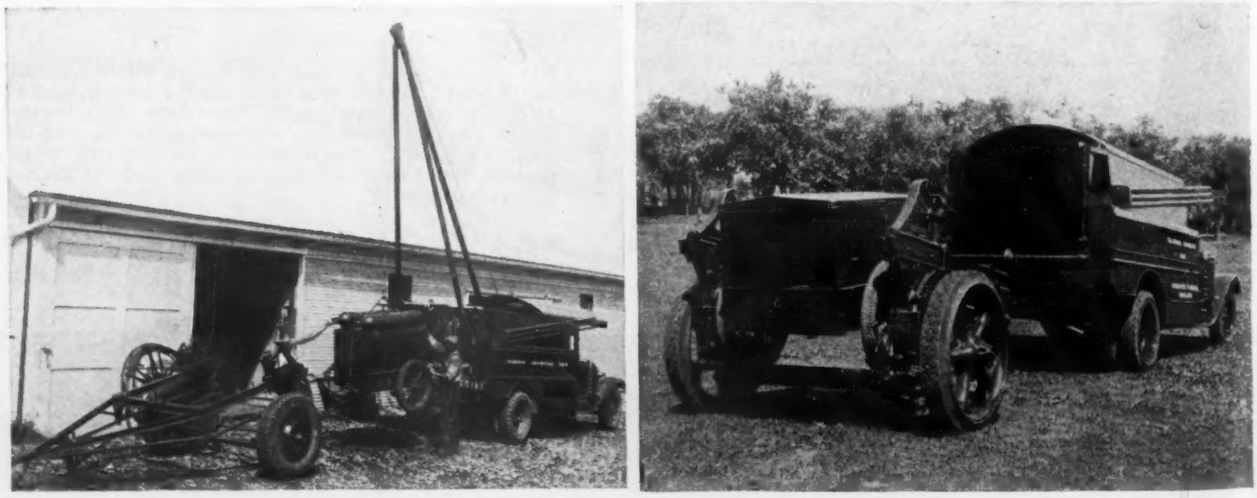
•

Simple Method for Hauling Two Trailers

By RAY BLAIN
Washington, D. C.

When it becomes necessary for one construction crew to cover a large area it is occasionally necessary to move both small trailers, such as cable splicing and cable reel or pole trailers, at one time. The method of hauling one trailer behind the other with one truck is neither convenient nor safe.

A simple method is to load the small trailer on the large one in the manner indicated in the accompanying illustration. The small trailer is elevated on a pole derrick and the large one rolled under it—or the skid method of loading may be used. This arrangement also permits faster traveling as small trailers cannot be hauled safely at high rates of speed due to their light and narrow tread.



LOADING small trailer on larger one by means of pole derrick (left); ready for hauling (right)

ASK YOURSELF THESE FIVE QUESTIONS!

Then Decide if You're Buying the Best Regulators for the Job to be Done. Here are the Facts on the Five-Way Savings You Get with the Allis-Chalmers 5/8% Step DFR Feeder Voltage Regulator!

1. **HOW CLOSELY DO THEY REGULATE?** Allis-Chalmers' DFR . . . with "Feather-Touch" Control . . . permits band width settings within ± 5/8 of 1%.

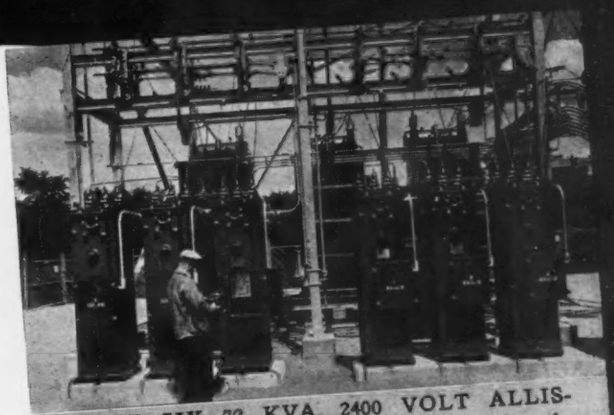
2. **DO THEY INCREASE WATTLESS CURRENT?** Actually excitation current of the DFR is *only a fraction* of that required by older types of regulators. That means you don't have to install costly static capacitors to release system capacity for pay loads.

3. **ARE THEIR LOSSES HIGH?** No . . . for at the neutral position, the copper loss of the Allis-Chalmers DFR approaches zero. You get more efficient operation in the range where the highest percentage of operations occur.

4. **ARE THEY TOO NOISY FOR URBAN STATIONS?** Quiet-operating DFRs . . . with no air gap, fringing flux, or clatter of relays . . . make no more noise than a distribution transformer of equivalent size.

5. **WHAT ABOUT MAINTENANCE EXPENSE?** No holding or braking devices are necessary on the DFR. And complete oil immersion of all moving parts eliminates the need for other lubrication. What's more, in the seven years Allis-Chalmers 5/8% Step Regulators have been in service, *not a single contact has ever been replaced due to deterioration under normal operation!*

For all the answers on the famous five-way savings of Allis-Chalmers 5/8% Step DFR Regulators, call the district office near you. Or write direct to Allis-Chalmers, Milwaukee, for your copy of our new bulletin B-6065. A 1312



THESE SIX 72 KVA, 2400 VOLT ALLIS-Chalmers 5/8% Step DFR Regulators on a northwestern system give the right answers to the five fundamental questions of regulator economy.

MEET REGULATION'S BIG FIVE!

*1. CLOSER REGULATION!
2. LOWER EXCITATION CURRENT!
3. REDUCED LOSSES!
4. QUIETER OPERATION!
5. MINIMUM MAINTENANCE COSTS!

***SIMPLIFIED "FEATHER-TOUCH CONTROL" PERMITS CLOSER BAND WIDTH SETTINGS!**

Because the energy handled by the relay contacts is small, no compounding or holding coils are necessary to prevent contact burning . . . the relay is free to follow each voltage fluctuation without excessive damping, resulting in the unique "Feather-Touch" action.

Coupled with the DFR's small steps — only 5/8 of 1%—this permits band width settings within ± 5/8% . . . closer regulation for your feeders.

These 5/8% Step Regulators Are Famous for Better Regulation at Lower Cost! Choose the Regulator to Fit Your Purpose!

DFR — 12 to 250 kva, single phase
AFR — 20.8 to 750 kva, three phase
CFR (air cooled) — 36-96 kva, 2400 volt, single phase

ALLIS-CHALMERS
MILWAUKEE·WISCONSIN

INDUSTRIAL ENGINEERING

PLATING SECTION kept clear for experimental work by wall bus

Compact Wiring Serves Research Laboratory

In the new laboratories of the Underwood Elliott Fisher Company at Hartford, Conn., a pilot electroplating plant used to guide operations in the manufacture of typewriters and other office machinery is equipped with about 17 kw. in electric heating units and about 3 kw. in plating apparatus. Located in a space about 30 ft. long by 20 ft. wide are an alkaline cleaning vat and rinse tank (at left in the illustration), acid pickle tank, copper plating tank, hot and cold water rinse tank, nickel, cadmium and zinc plating tanks, a rectifier control panel and a chromium plating tank. All the electroplating baths are heated to controlled temperatures by 220-volt, single-phase immersion units of 2 to 5 kw. rating.

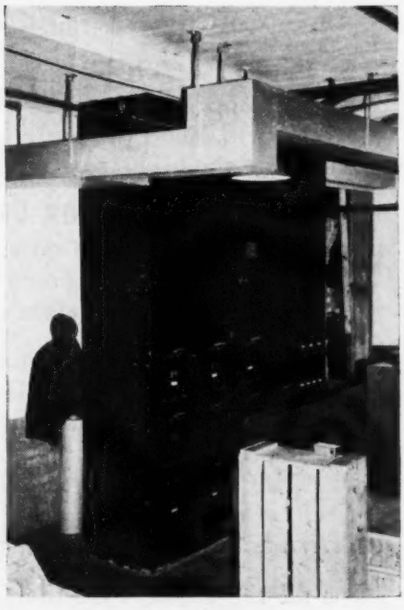
Current for plating is supplied from 2x¼-in. buses to the various tanks by Burndy taps and flexible cable connections, control and instrument panels for these units being mounted on the wall behind the tanks and giving a short run of copper to each tank. Direct current for this service is provided by a copper oxide rectifier in another room, the control panel giving a range of from zero to 8 volts on the bus, which has a maximum capacity of 300 amp. Service for the heating units is supplied through rigid conduit connections at the rear and also wall mounted. A 1-hp. motor-driven fan in the upper part of the room removes all fumes from the tanks through a duct system as shown.

The entire wiring layout is notable for its simplicity of arrangement, facilitating both routine service and any future changes which may be required to meet the requirements of research.

•

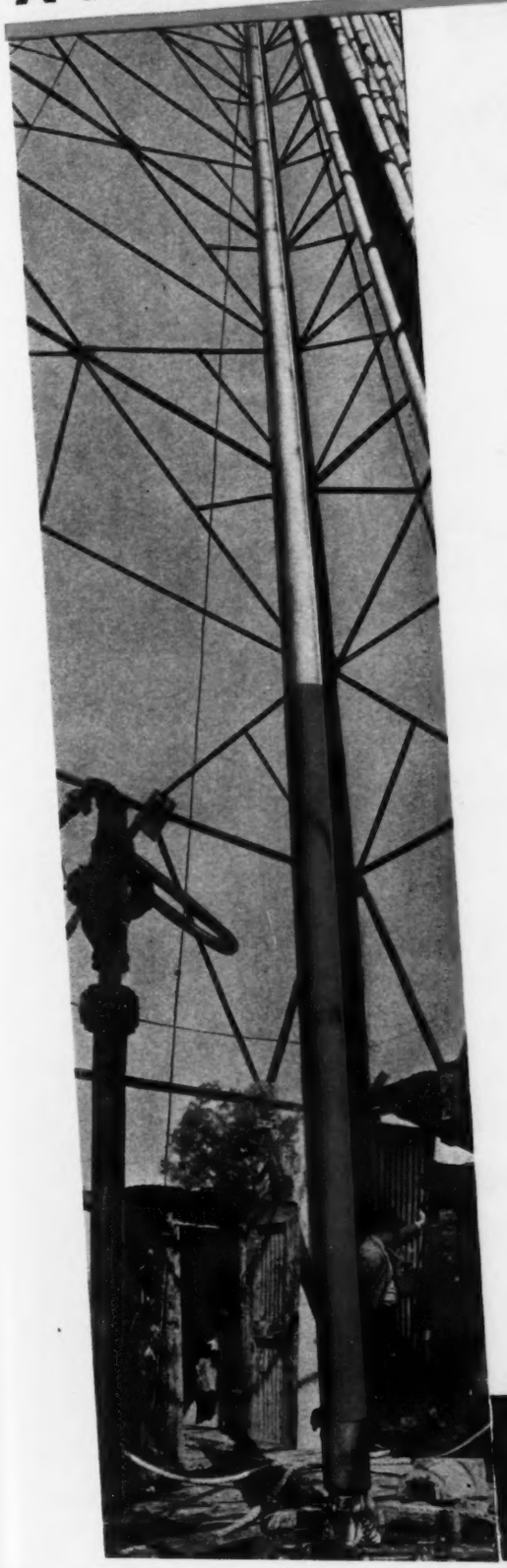
Inclosed Feeder Bus Conserves Space

When the east wing of the Minneapolis-Honeywell Regulator Company at Minneapolis, Minn., was expanded some three years ago it became necessary to erect a main feeder for three-phase and single-phase power to handle the increased load, which was in effect an extension of the bus from the main switchboard to the distribu-



THREE-PHASE and single-phase feeder buses in same inclosure installed where ceiling space was too limited for a conduit. Three-phase bus terminates at distribution center, single-phase bus continues to right

An Oil Well Drill Sends "Telegrams" from A Mile Underground . . . . . thanks to



DILECTO

LAMINATED PHENOLIC PLASTIC

"Simultaneous Electric Logging" has caused excitement in the oil fields. To survey and record the earth's formation while drilling was the objective. To insulate the electrodes from the steel drill stem was the greatest problem.

1,300,000 lbs. Pressure

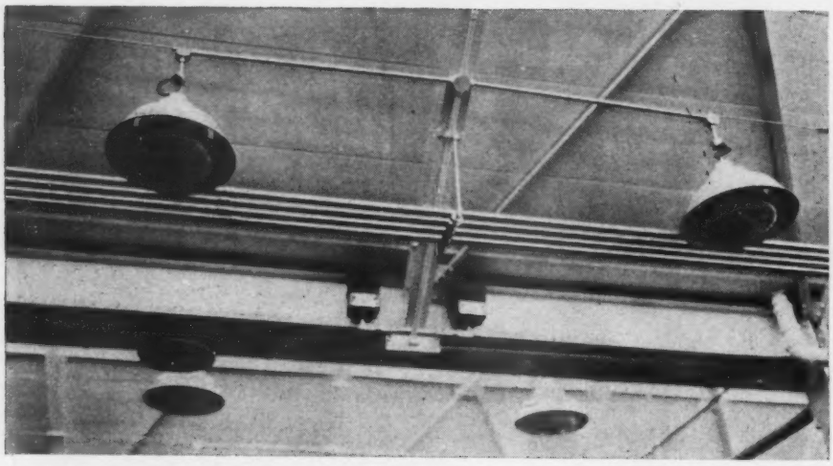
In close collaboration with Mr. David G. Hawthorn of Amerada Petroleum Corporation, Continental-Diamond produced a threaded 10 foot collar of laminated, canvas base DILECTO 3/4 in. thick, that withstood *1,300,000 lbs. pressure.*

Terrific Abrasion

Plus this enormous pressure the insulated section was subject to the extremely high torque of rotary drilling and terrific abrasion from rock and sand. But, here again, DILECTO proved it could stand the gaff by showing an average life of 7,500 ft. of drilling before replacement.

While you may never call upon insulation for such performance as this, it's good to know that the same Continental-Diamond Engineers who developed it are ready to help solve your insulation problem.

CONTINENTAL-DIAMOND FIBRE CO., *Newark, Del.*



MESSENGER SUSPENSION of lighting units provides flexible support and freedom of conduit arrangement

tion center in the wing. Concentration of power due to expansion was such that had the main feeders been carried in conduit the installation would have bulked too large for the available ceiling space.

The bus arrangement was housed in a 9x18-in. rectangular metal inclosure which contains two ¼x3-in. copper bars per phase for the three-phase, 220-volt power feeders and three single ¼x3-in. bars for the 110/220-volt system. Buses were supported at 4-ft. intervals within the inclosure on ½-in. Bakelite spacers bolted to the inclosure. Transpositions were made in the bus at 85-ft. intervals to minimize reactance losses, since the bus was several hundred feet in length.

The bus is shown in the accompanying illustration at the point where it comes into the distribution center. Here the three-phase system bus terminates, but the single-phase bus continues (to the right) in a 9x9-in. inclosure.

•

Messenger Wire Supports Light

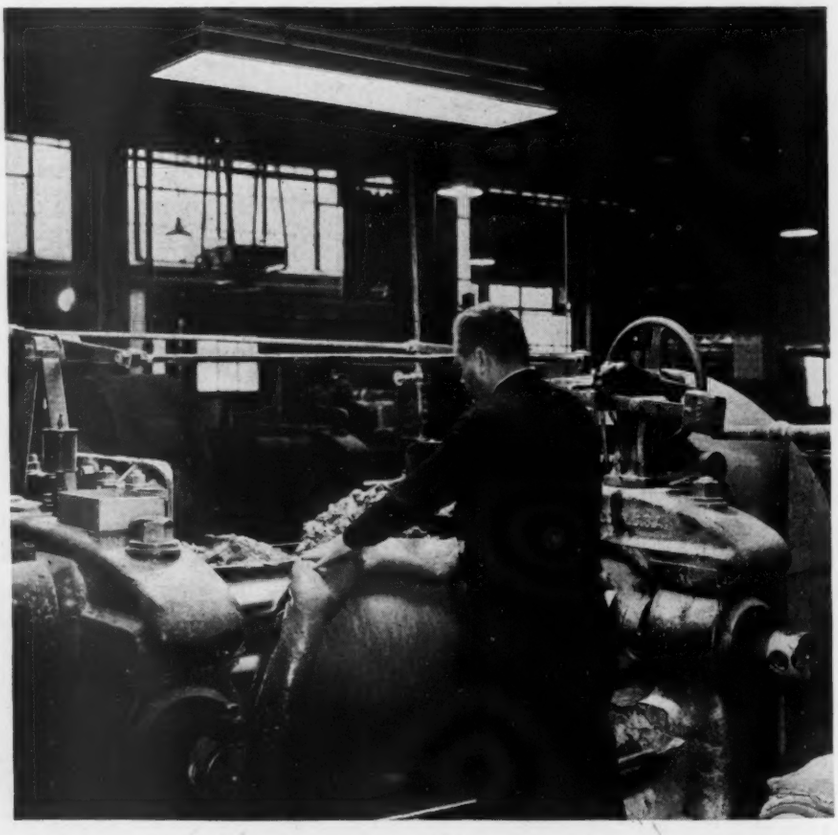
Lighting unit suspension by a ⅜-in. steel messenger wire attached to the overhead steel framing of the Heald Machine Company's drafting room at Worcester, Mass., provides a flexible means of support, leaving the wiring conduit free for convenient attachment to a circular fitting fastened to the bottom of the diagonal I-beams under the sawtooth roof panel shown.

Each unit consists of a 400-watt high-intensity mercury lamp mounted with three 150-watt tungstens in a common luminaire, and the autotransformers required by adjacent units are likewise mounted against the steel structural I-beams in pairs as indicated. The arrangement insures economical use of wiring material, short and symmetrical runs to the lamp units, ease of access and convenience in relocating lamps, as well as simplicity of layout.

Fluorescent Light for the Rubber Mill

Mill rolls in a rubber plant furnish a good example of an industrial area where localized illumination is needed to supplement the general overhead lighting. This type of lighting, to be fully effective, requires that the lighting units be mounted in a definite location with respect to the machine, or work area, so that correct illumination values will prevail at those points. At the same time the fixture should be so located that enough light is provided in the space surrounding the machine in order to permit safe movement of men and materials.

In a rubber plant mixing of the raw materials is done on a mill equipped with two rolls, the gummy rubber and compounds being compressed between them. Seeing requirements are stringent, since the operator judges his work by the feel and appearance of the sticky mass. For this seeing problem the fluorescent fixture, with its readily available high illumination intensities, provides a modern answer.



MOUNTED directly above the rubber mill, this Westinghouse RLM 48-in. twin-lamp fluorescent fixture provides high illumination on the mill rolls—most important work area—and lights surrounding areas as well

READY FOR RISING LOADS

Faster than ever before the bigger sizes of L-M Distribution Transformers are rolling off the production line. In the 37½ Kv-a and 50 Kv-a range, and up to 200 Kv-a—as well as in the smaller ratings—Line Material stands ready to furnish you with any transformer you need to handle the rising load.

LM

LINE MATERIAL CO.

MAIN OFFICES, MILWAUKEE, WISCONSIN

NEW ENGINEERING IDEAS

Shock Currents Seldom Hit Brain

The path or paths of current caused by electric shock can usually be determined with some accuracy by considering the points of contact, evident by current markings or exposed conductors of the electrical system. However, the current distribution for various areas in the path cannot be readily estimated. Knowledge of this is of considerable importance in evaluating the effects of shock since it has an important bearing on the type and severity of physiological damage.

An experimental investigation of 60-cycle alternating current is described in the *Journal of Industrial Hygiene and Toxicology*, December, 1939, by Dr. Leo Alexander and Arthur W. Weeks. A small hinged core transformer was used to surround the portion being observed. Calibration of the complete assembly was made by passing known values of current through the opening of the current transformer and noting the galvanometer deflections. Because of the high gain of the amplifier (about 10,000 to 1) it was possible to determine primary currents of less than 0.1 milli-amp. The output voltage of the transformer was about 3 microvolts for a primary current of 0.1 milli-amp.

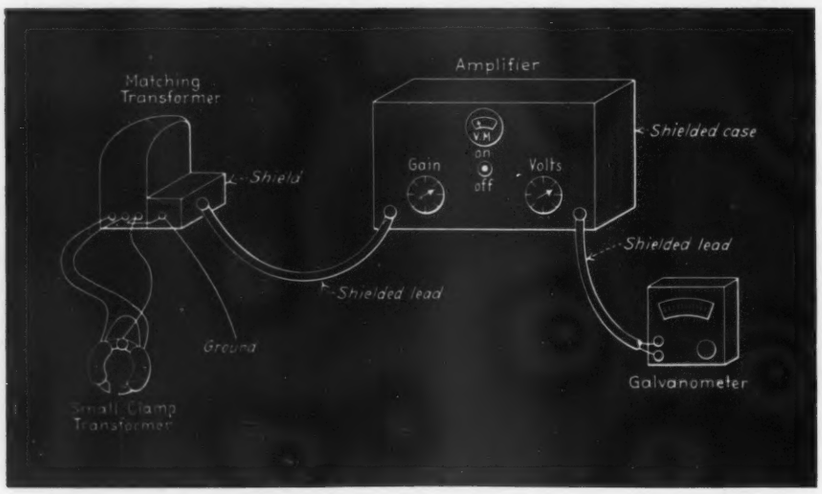
The transformer was clamped around various parts of the animal body—such as the sciatic nerve, the spinal cord, certain blood vessels, small bones, parts of the brain and various muscles. Current was passed through the body by way of several points of contact. Cats anesthetized with membutal were used. The following results were noted:

When a current was passed from one hind foot to the other about 0.75 per cent (with a variation of 0.5–1.4 per cent) of the shock current flowed through the sciatic nerve. No current was detected above the hips.

No current was detected in the brain when forefoot to hindfoot connections were used. When studying the flow of current through the heart the current measured by the transformer was about 3.8–4.5 per cent of the total, the average being 4.1 per cent of the total shock current. This was consistently shown by eight different measurements with currents varying from 40–100 milli-amp. After rigor mortis set in this value dropped to 2.5 per cent. This should emphasize the importance of such measurements in living organs.

When the shock current flows from forefoot to forefoot a portion of the current flows through the spinal cord; none, however, could be detected in the brain.

The results showed that the current took the shortest path from one point of contact to the other, irrespective of anatomical landmarks. Also, no current could be detected in any part of the brain when the shock current was passed from limb to limb, affording evidence for extended application of resuscitation.



ARRANGEMENT of shock study apparatus

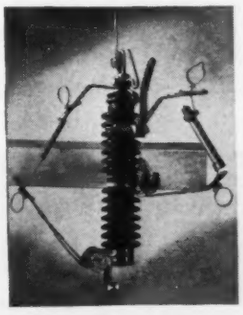
Small Breaker Has Co-operative Trip

By L. W. DYER
Westinghouse Elec. & Manufacturing Company, East Pittsburgh, Pa.

Successful combination of thermal and magnetic trip actions into one co-operative tripping unit—a small circuit breaker—by Westinghouse circuit breaker engineers make possible a breaker whose operating curve may be adjusted to almost the ideal for any protective scheme. It gives the advantage of having, in a single circuit-breaking unit, protection that is instantaneous on short circuits, but

FROM THE ENGINEERING DEPT.—JAMES R. KEARNEY CORPORATION

Lightning Protection



For fault and lightning protection—combination Trip-O-Gap Trip-O-Links 5,000 to 7,500/12,500 Y Grd. Volt.

A STUDY of lightning characteristics combined with product design research disclosed that inexpensive lightning arresters (such as the Kearney Trip-O-Gap, above, and Trip-O-Gap Trip-O-Link, at left, 5000 to 7500 volts) could handle two important functions: (1) Provide a direct low resistance path to ground for lightning or other high voltage disturbances, and (2) interrupt the line to ground short at first current zero when created by the high voltage discharge.

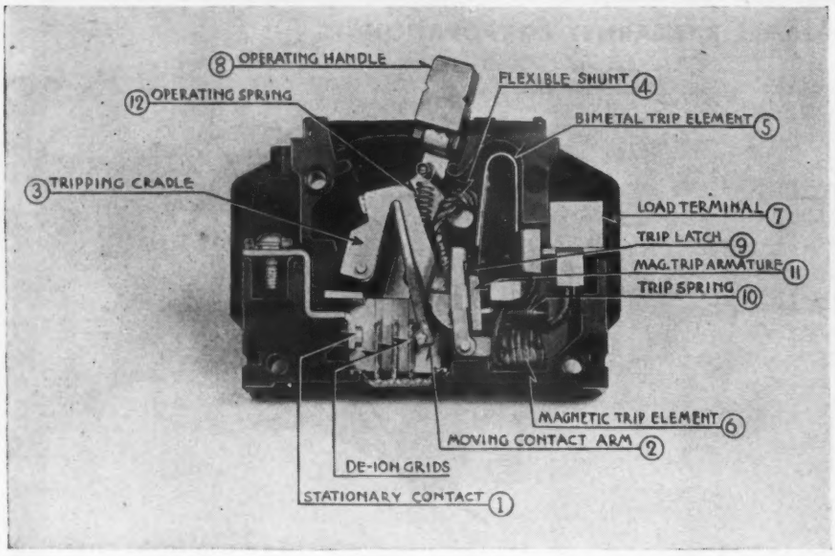
Further investigation and tests showed that an expulsion gap type of arrester would successfully handle the job . . . The result — a good, low-cost arrester . . . cannot freeze a short on the line . . . exposed series gap—to avoid trapping conductive gases within the assembly . . . resiliently suspended tube gap—to absorb excessive mechanical impacts . . . 75c replacement tube gaps—to restore an arrester to service if an excessive discharge should damage the tube.

Now—on the strength of the outstanding performance records of these arresters, through several lightning seasons—we'll let you try them out, as you see fit—on a 90-day, money-back trial basis. Ask your Kearney Representative—or write direct for details and present low prices.

JAMES R. KEARNEY CORPORATION
4236 Clayton Ave., St. Louis, Mo.
Canadian Plant - Toronto, Canada.

Use **KEARNEY PRODUCTS**

FOR BETTER MAINTENANCE and CONSTRUCTION



SMALL CIRCUIT BREAKER combines in a single unit a co-operative thermal and magnetic trip

has a definite time delay on momentary or safe sustained overloads.

Co-operative action is obtained by using two separate trip elements, a bi-metal and a magnetic element, both working on the same tripping latch. The two elements work against each other; that is, they exert opposite and equal forces on the tripping latch, maintaining a balanced equilibrium, one tending to trip the breaker, the other tending to hold it closed. A change in either force, caused by an overload, breaks the equilibrium, either instantaneously or gradually, and trips the breaker.

Breaker Operation

In the new circuit breaker, as shown in the accompanying illustration, the line is normally connected to the stationary contact (1). In operation, current flows from this terminal through the moving contact arm (2), tripping cradle (3), flexible shunt (4), bi-metal element (5), coil of the magnetic element (6) to the load terminal (7).

When an overload occurs the breaker trips by mutual operation of the bi-metallic and the magnetic elements. Operation of these elements releases the tripping cradle by breaking the trip latch (9). When this happens the cradle swings upward to the right, displacing the dead center position of the operating spring (12). In its new position, the operating spring pulls the moving contact open.

The trip latch is normally in the latched position, as shown. The trip spring (10) tends to unlatch it by the pull which it exerts on the magnetic trip armature (11). This pull, or unlatching force, is balanced by an opposite force exerted by the bi-metal element. Thus a state of sensitive equilibrium exists, which can be broken by either of, or a combination of, two things, each a direct result of an overload:

1. Heating of the bi-metal, with consequent reduction of its retaining pressure which acts to hold the trip latch closed.
2. Increase in magnetic flux, caused by a heavy current through the magnetic element's coil, adding a magnetic pull to the pull exerted by the spring.

On light loads the magnetic element is not sufficiently strong to influence the armature to any great extent and tripping is accomplished by action of the bi-metal only. As the overload increases, the magnetic element exerts more and more influence, assisting the bi-metal in its tripping action. Should the overload be high enough, the magnetic element will trip the latch by itself. Such co-operative action assures high-speed tripping on heavy overloads, yet gives the time-delay so necessary to pass momentary overloads.

• • •

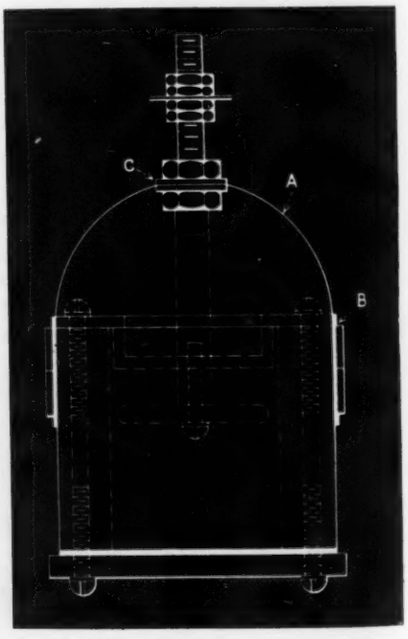
Regulator Dashpot Uses Neoprene Seal

A flexible cup-shaped neoprene diaphragm, 0.005 to 0.007 inches thick, fulfilled the necessary service requirements for a diaphragm at the top of a dashpot controlling the stability of a generator voltage regulator. These requirements included flexibility to permit $\frac{3}{8}$ in. travel of the piston and retention of this flexibility over long periods of time, resistance to the "Univis" 90 oil in the dashpot and, primarily, low mechanical hysteresis.

Examination of this seal after laboratory tests, in which the piston in the cylinder was moved from one extreme position to the other for more than 30,000,000 complete cycles, showed that the seal remained in perfect condition despite this extensive operation. Service results are expected to bear out this prediction of long, trouble-free operation.

The diaphragms are used on the Bulletin 5651 voltage regulators of the Ward-Leonard Electric Company, Mount Vernon, N. Y., designed for small and medium size generators.

NEOPRENE DIAPHRAGM seal (A) prevents loss of oil from voltage regulator dashpot. Oil- and air-tight seal is obtained at (B) and (C) by coating cylinder and washers with neoprene cement before assembly



If the demands for extra circuits have gotten to the point where you no longer have spares in your control or signal cable then it is time you were thinking of replacements. If you continue to use the heavy wall of insulation on your conductors that has been customary until recently then you will probably have to enlarge conduits you are using in order to pull in the proper number of circuits. But if you want to save some money then the thing to do is to pull in Simplex - LATOX insulated cables.

When compared with conventional cables Simplex-LATOX insulated cables contain more than 300% as many conductors, yet the diameter is approximately the same. Here is just one example. A conventional cable having 19 — No. 16 solid conductors is approximately .97 inch in diameter, yet a LATOX insulated cable can have 61 — No. 16 solid conductors and still be only 1.02 inch in diameter. That's only .05 inch greater diameter.

We will be more than glad to send you a copy of the new LATOX Data Sheet No. 101 which has just come off the press. It has all the latest information and specification values on Simplex-LATOX insulated conductors.

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge, Mass.

Simplex – LATOX

Thin insulation made directly from rubber latex

LOAD BUILDING

Teaching Men to Cook Electrically

From a timid start and and hesitant acceptance three years ago, the idea of teaching men how to cook electrically has taken root at Fall River, Mass., with such enthusiastic interest in 1940 that shortly no less than 100 grocery clerks will have taken a course in this subject sponsored by the Fall River Electric Light Company. Ten valiant males have recently "gone through the mill" and received certificates of their ability at the hands of Harry W. Hale, sales manager of the company, following eight lessons under the supervision of Miss Betty Sullivan, home economist of that utility. Like a rolling snowball, the movement has gained impetus in the community, and this without other advertising than word of mouth, a newspaper "stick" or so, and the incentive of free tuition.

At the outset there was a disposition on the part of the men to "shy" away from the undertaking, probably from apprehension of "spoofing" by Friend Wife and others. This attitude gradually disappeared as the students became interested in the use of electric kitchen appliances, and their natural inclinations in the direction of "doctoring up" tasty viands were encouraged. Three electric ranges were used, one being assigned to the instructor. The company spent something like $15 for cooking materials. Lessons were given from 7 to 9:30 on one evening a fortnight. Grills, toasters, percolators and other equipment were utilized, and for "home work" the class experimented, if that is the word, with the previous week's recipes, reporting results at the next session.

The class actually did most of the cooking, thus becoming familiar with the speed, comfort and economy of electric service. Only plain cooking was taught, but the results are getting to be the talk of the town. The class included a doctor, barber, chemist, office manager, lumber supply dealer and milkman. At the end of the pastry lesson each student had his rolling pin autographed by the instructor and his classmates. Two washers, a mixer and a range were sold soon after the course.

AWARDING of certificates by utility sales manager of Fall River (Mass.) Electric Light Company to future Escoffiers. Students included local doctors, barbers, chemists, office managers and other customers

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Power Sales Display Wins Industry Favor

To Lewis Carroll's walrus of "Alice in Wonderland" fame goes credit, certainly for the theme, and possibly the timing of Wisconsin Public Service Company's recent successful power-sales advertising campaign. Dramatizing the low power-cost component of typical Wisconsin industrial products, the company through its advertising speaks of "chairs and chicks and piston rings, of cheese and other things."

Fifteen serial advertisements were used in the latest campaign, each graphically comparing the cost of power to produce typical Wisconsin industrial products with the cost of such homely things as tacks, paper clips and clothespins. Cleverly worked into each dispay was a simple bar or pie chart that compared payroll and taxes with electric power as a percentage of production cost for the product pictured. Data used in the preparation of the displays and a typical advertisement are shown on page 96.

The campaign arose out of a conviction that power customers and

THE SATURDAY EVENING POST
77
OUR BOARDING HOUSE
MAJOR HOOPLE
WHATCHA GOT, UNCLE AMOS— A MOUSE TRAP?
EGAD, NO, ALVIN! THIS CUNNING LITTLE INVENTION IS THE HOOPLE BULB-SNATCHING TRAP, SCIENCE'S LATEST AID TO LIGHT CONDITIONING!— PLACED WITHIN THE BOWL OF AN I.E.S. READING LAMP, IT ADMINISTERS A STARTLING BUT HARMLESS NIP TO THE FINGER OF THE MALEFACTOR WHO IS ABOUT TO SNATCH A BULB FROM ONE SOCKET TO FILL ANOTHER!
THAT REMINDS ME, EDISON HOOPLE! I SAW YOU SNEAK THE 150-WATT BULB OUT OF MY KITCHEN LAST NIGHT!— SNAP THAT TRAP ON YOUR THUMB AND TAKE THIS DOLLAR DOWN TO THE CORNER FOR A CARTON OF NEW G-E MAZDA LAMPS!
BRIGHTER THAN EVER . . . NEW LOW PRICES!
7½, 15, and 25 watt, now only . . . . . 10¢
40, 50, and 60 watt, were 15¢, now only . . . . 13¢
150 watt silvered bowl, was 55¢, now only . . 45¢
75 and 100 watt, previously reduced to . . . . 15¢
100-200-300 watt 3-lite, previously reduced to 60¢
Many larger sizes also reduced
Made to stay brighter longer
G-E MAZDA LAMPS
GENERAL ELECTRIC
THE MAJOR BETTER NOT LET HER KNOW HOW MUCH G-E MAZDA LAMP PRICES HAVE COME DOWN, OR SHE'LL EXPECT SOME CHANGE BACK!
Enjoy the G-E MAZDA Lamp "Hour of Charm", Sundays 10 P. M., E. S. T.—NBC Red Network

ADS LIKE THIS totalling more than four hundred million circulation in magazines and newspapers this year, are selling *your* customers on the perils of "bulbsnatching". . . a term that has rapidly become a household word. This kind of good humored advertising is helping to fill the empty sockets on your lines because it gets read *all the way through!* General Electric Company, Nela Park, Cleveland, Ohio.

prospects of the company were not fully aware of that part of total product costs represented by power. Accordingly, the first objective, ahead of the advertising campaign itself, was to sit with industrial executives and get them to figure the cost of power for their products. Because the figure was low in nearly every case initial interviews, aimed at securing co-operation for an advertisement covering their business, had a good effect and co-operation was general. Inclusion of tax and labor statistics for the industries proved a powerful selling factor in getting each industry

Speaking of
TISSUE
and
TACKS
The Electric Power used to produce one roll of Tissue is about equal in cost to a common Thumb Tack
THE great paper mills of Wisconsin with their huge electrically operated machines have brought distinction to this state for the outstanding quality of its paper products. The paper mills mean much to the progress and success of the communities in which they are located — furnishing employment to thousands — and keeping hundreds of thousands of dollars circulating in the very life-stream of those communities.
As in the case of many industries, the paper mills must choose locations where power costs are low. This is an important reason why paper mills were started — and have remained in the territory served by the Wisconsin Public Service Corporation. For, compared with labor costs and taxes — the cost of electric power is amazingly low. With all the mighty machines required to make paper—the cost of the "Public Service Power" used in producing a roll of toilet tissue is only 1.28 mills—about the cost of a thumb tack!
WISCONSIN Public Service CORPORATION
THE ENTIRE ELECTRIC SERVICE BILL FOR THE AVERAGE FAMILY COSTS LESS PER DAY THAN THE PRICE OF A PACKAGE OF THUMB TACKS.
Electricity IS CHEAP
-- IN STORE, SHOP AND HOME, AS WELL AS IN INDUSTRY

ONE in a series of fifteen advertisements of Wisconsin Public Service Company dramatizing low cost of power used in making local industrial products

to tell its power cost story. Where firms were reluctant, a few words about the need for public information on the worth of the industry's taxes and payroll to the community soon sold the plan.

The effect of the advertising, and especially of publishing it as general information to all newspaper readers, might be summarized as follows:

1. Accumulation of statistics has aided in telling the story of low power rates to the key men in various industries.
2. Addition of the labor and tax figures has shown these executives that if costs have to be cut, more can be done in these brackets than through the use of some other power source.
3. By offering utility advertising space as a place for industry to tell its "civic position" story to voters and the public generally, the company has pleased industrial leaders.
4. The story of the aid that the utility has given labor-employing industries demonstrates the value of Public Service electricity to the public beyond the mere rendering of domestic electric service.
5. Conceivably, the campaign offers Chamber of Commerce leaders an opportunity to press the advantages of the communities served by the Wisconsin company upon other firms in the industries illustrated.

Per Cent of Production Cost

Type of Industrial Product	Electric Power	For Taxes	Payroll
1. Foundry Castings...	1.0	4.0	60.
2. Tissue Paper	4.1	12.2	30.17
3. Condensed Milk	0.41	2.30	22.23
4. Cheese	0.43	2.25	21.71
5. Canning	0.4[illegible]	2.28	22.62
6. Beer	0.83	45.0	4.87
7. Shoes	0.5	2.1	27.2
8. Farm Implements....	3.0	5.7	56.0
9. Furniture — Chairs..	1.0	3.0	50.0
10. Knitwear	0.26	1.43	28.93
11. Gloves	0.50	2.43	43.0
12. Electric Motors.....	0.75	3.25	23.3
13. Shipping Boxes.....	1.4	2.1	19.7
14. Piston Rings.....	1.5	8.0	42.5
15. Water Pumping.....	$0.02/1,000 gal. (average 8 Wisconsin cities)		

As these advertisements have been published they have been called to the attention of firms within the industry dramatized. Thus, the power company has gained the full advantage of direct advertising to such groups and has added to it a background of civic publicity which has been unusually helpful in different ways.

In one instance the company was petitioned by a cheese producers group to do the same thing for their industry that had been done for the condensed milk people. They were pleased to find that the advertisement had already been prepared. Several groups concerned asked, after supplying the needed information, what the cost was going to be. Upon learning that there was no cost, they said that it was a real gift as the publication of the tax and labor information was worth "plenty" to them.

•

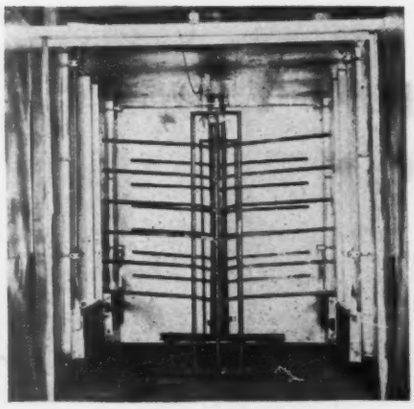
Oven Improves Finish on Gasoline Pumps

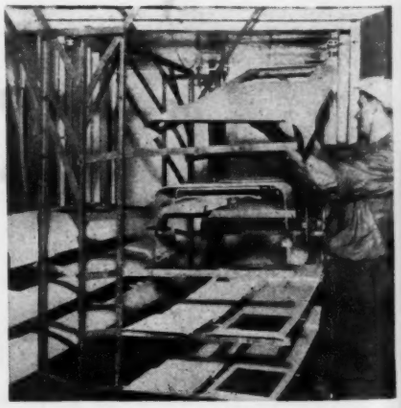
S. F. Bowser & Company, an Alhambra, Calif., firm, has improved its process of finishing gasoline pumps for automobile service stations. This the firm accomplished by building itself a sheet-steel oven and by installing electric heat in collaboration with industrial engineers of Southern California Edison Company.

The oven, which measures 5x5 ft. by 6 ft. 6 in. high, accommodates some 120 sheet-steel sections of pump casing. These sections are supported in the oven by a special rack.

Four 3.8-kw., 110-volt General Electric oven-type heaters were installed in the oven just above the floor at the rear end. Operating at 440 volts, these are controlled by a thermostat in the center of the ceiling to hold temperatures at 200-300 deg. F. The control circuit is 110 volts. A safety switch on the door forestalls the possibility of a workman coming in contact with an energized heater. To prevent heat loss 2 in. of rockwool insulation is provided.

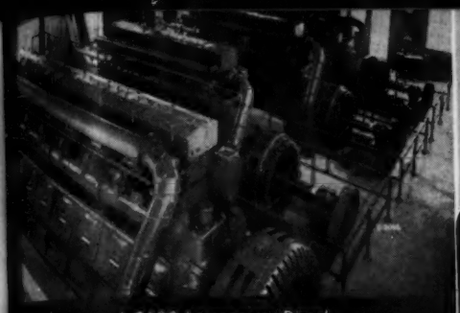
The electrical equipment cost about $137. It has enabled the firm to speed up production—baking time averages 50 minutes—and to turn out a more lustrous and more durable finish. In addition, the customer has considerably improved his ratio of consumption to connected load.



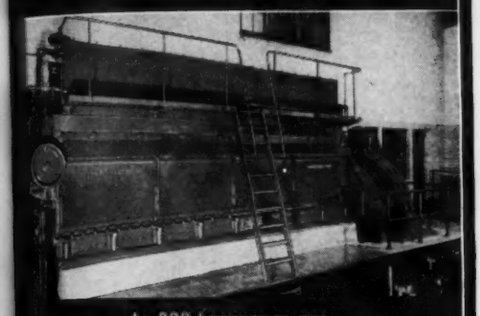


GENERAL VIEW of interior of oven. Four 3.8-kw., 110-volt heaters, operated in series on a 440-volt circuit, are thermostatically controlled (left). Method of packing oven. More than 100 sheet-steel sections such as these are baked in one batch in 50 minutes (right)

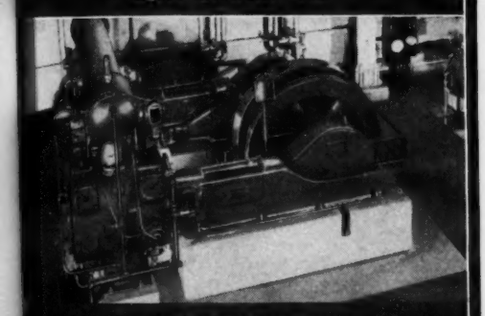
WORTHINGTON



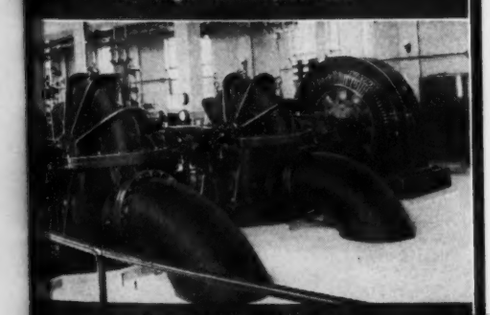
A 2500-horsepower Diesel engine generating plant



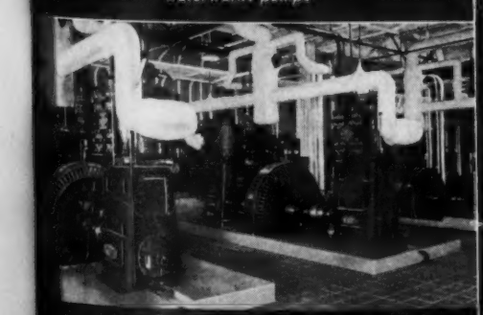
An 800-horsepower gas engine generator unit



A horizontal duplex compressor for large air requirements



Motor-driven centrifugal waterworks pumps



Vertical refrigeration compressors for air conditioning and ice plants

An angle type compressor for medium air supply

EQUIPMENT *for the* POWER PLANT

DIESEL ENGINES
4-cycle direct-injection and air-injection types.

GAS ENGINES
Horizontal 4-cycle double-acting and vertical 4-cycle single-acting types.

CONVERTIBLE GAS-DIESEL ENGINES
Vertical 4-cycle, readily and quickly convertible for operation on either gas or fuel oil.

STEAM TURBINES
All types, for generator and equipment drives.

SPEED CHANGE GEARS
Reducing and increasing.

STEAM CONDENSERS
Surface, barometric and jet types, for all ranges of capacity. Complete systems with auxiliary pumps, ejectors, etc.

STEAM-JET EJECTORS—(For Vacuum Service)
For moderate to high vacuum. One-stage to four-stage, with pre-condensers, inter-condensers and after-condensers.

VACUUM PUMPS
Rotative Dry Type—Horizontal and vertical; single-stage and two-stage. Electric or steam drive.
Direct-Acting Wet Type—Horizontal single-stage.

FEEDWATER HEATERS AND DE-AERATORS
Open type; for individual requirements.

WATER PURIFICATION EQUIPMENT
Pressure and gravity type filters.

AIR AND GAS COMPRESSORS
Stationary—Horizontal, vertical and angle types, single-stage and multi-stage. All types and sizes. Electric, steam, Diesel engine or gas engine drive.
Portable—Two-stage, air-cooled, all types of mountings. Gasoline, Diesel or electric motor drive.

REFRIGERATING AND AIR CONDITIONING EQUIPMENT
All types, including NH_3, Freon-12, CO_2, etc.; compression, absorption, steam-jet and centrifugal refrigeration.

V-BELT DRIVES—(Multi-V-Drive)
Complete drives, sheaves or belts only.

CENTRIFUGAL PUMPS — HIGH-PRESSURE MULTI-STAGE AND GENERAL SERVICE
For boiler feed, pressure applications, circulating, water supply, sewerage, flood control, other general services.

TURBINE WELL PUMPS
For water supply, drainage, sump, other services.

STEAM PUMPS
All types, horizontal and vertical.

POWER PUMPS
Hydraulic press, boiler feed, varied water services.

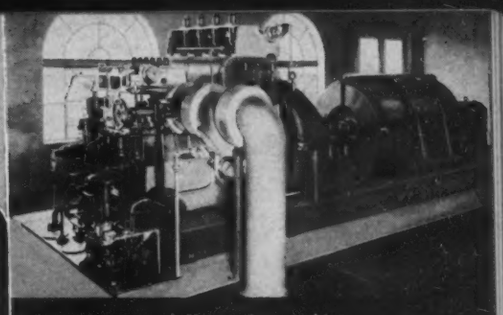
ROTARY PUMPS
For transfer of non-abrasive liquids.

LIQUID METERS
For hot or cold water, chemicals, etc.

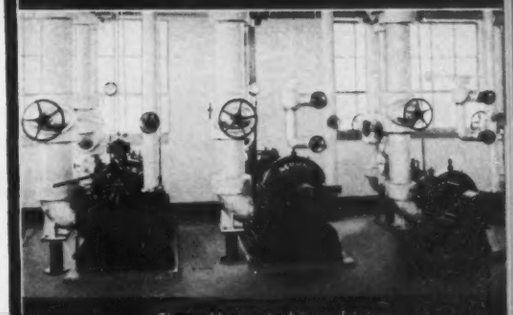
CONSTRUCTION AIR TOOLS
Clay diggers, trench diggers, tampers, pavement breakers, etc.

ICO-50

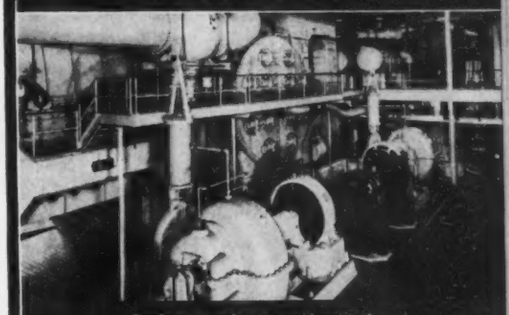
WORTHINGTON PUMP AND MACHINERY CORPORATION
General Offices: **HARRISON, NEW JERSEY**
Offices and Representatives in Principal Cities



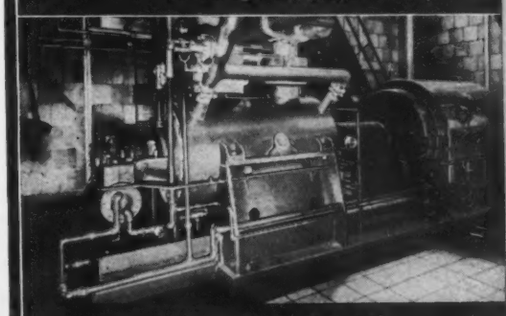
A Moore steam turbine generator unit



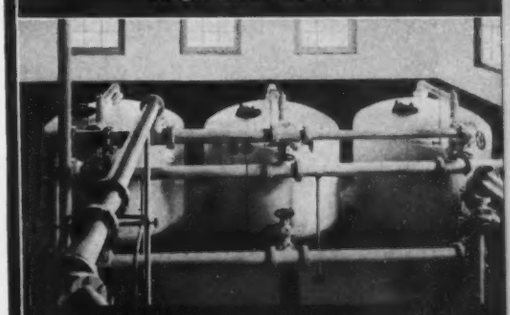
Three Moore turbines driving centrifugal boiler feed pumps



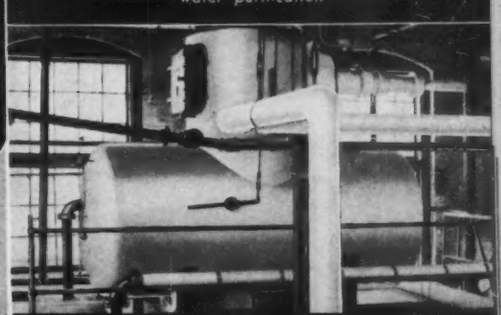
Surface condenser and centrifugal circulating water pumps



High pressure, six-stage centrifugal boiler feed pumps



Pressure filters for water purification



An open type deaerating feedwater heater

NEW EQUIPMENT

Level Control

Electronic relay provides for level control of both conductive and non-conductive fluids and powders. Since the probe or electrode circuit carries only milliamperes

Type "P30" electronic level control. **Photoswitch Inc.**, Cambridge, Mass.

of current and low voltage even when used with non-conducive fluids, the relay may be used with combustibles, it is stated. Equipment is offered for single level control, on-and-off control at two levels, boiler feedwater control and tank condensate signals. Installation merely entails attaching a probe fitting, wired to the electronic relay, to the surface of the tank.

•

Water Purification

Water softeners and pressure filters. **Worthington Pump & Machinery Corp.**, Harrison, N. J.

Marking its entry into the water purification field, this company has announced completion of research and design standards for hot process water softeners and pressure filters for all capacities.

•

Oil Filters

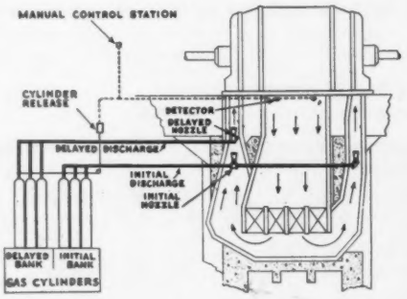
"FerroFilters." **S. G. Frantz Co., Inc.**, 161 Grand St., New York, N. Y.

Coarse and small iron particles (even as fine as 1/25,000-in. diameter) are magnetically extracted from suspension in lubricating oil circulating systems with these filters, which consist essentially of a stack of magnetized screens inclosed in a cylindrical casing through which the oil flows. Set close to the engine in the oil pipe line, the filter thus becomes part of the lubricating oil system. Permanent magnet types—two models—handle 20 or 10 U. S. gal. per minute. Electrically energized types—operating on d.c. at 110-120 volts—range in capacity from 20 to 200 gal. per minute, are made in three types—gravity, underfeed and pipe line—in pipe sizes from 1 to 3 in. I. P. S.

•

Generator Protection

As a new development in the protection of rotating electrical machines from fire, this company announces special shielded nozzles for the discharge of carbon dioxide into the ventilating ducts of generators in the event of fire. As shown, the shielded nozzles are affixed to both the initial discharge and the delayed discharge pipes carrying the carbon dioxide from the storage cylinders to the ducts. The refinement is said to eliminate objectionable



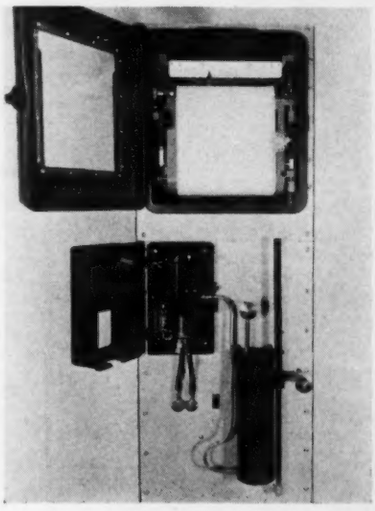
Illustrating new refinement in generator protection with carbon dioxide. **Walter Kidde & Co.**, New York, N. Y.

high jet velocity and turbulence, to aid a more rapid and uniform distribution of the gas throughout the machine.

BUYING ELECTRICAL EQUIPMENT?—"Electrical World" *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

Corrosion Control

As an aid to boiler system corrosion control, this company has developed a completely automatic instrument that provides a continuous indication and record of the



Dissolved oxygen recorder; range of 0 to 1 part of dissolved oxygen per 1,000,000 parts of water; records full scale on 10-in. wide chart. **Cambridge Instruments Co., Inc.**, Grand Central Terminal, New York, N. Y.

concentration of dissolved oxygen in the feed water entering the boiler. Operation of the metering unit is based on the thermal conductivity principle wherein four platinum spirals forming four arms of a Wheatstone bridge are employed. Two of the spirals are exposed to the sample gas and two are sealed with saturated hydrogen. When the exposed spirals are surrounded by a mixture of hydrogen and oxygen, their temperature will decrease due to the lower thermal conductivity of the mixture, causing a change in resistance of the spirals with a consequent unbalance of the bridge circuit.

•

Fluorescents

Fluorescent continuous luminaires. **Westinghouse Elec. & Mfg. Co.**, East Pittsburgh, Pa.

Designed especially for single or continuous strip illumination, a new line of surface-mounting fluorescent luminaires for commercial interiors has been announced.

An angle type compressor for medium air supply

Offices and Representatives in Principal Cities

An open type deaerating feedwater heater

WHEN YOU BUY **HUBBARD 4-11-44 WIREHOLDERS**

THEY HAVE BEEN EXPOSED TO A MOST CAREFUL SCRUTINY FOR MANY YEARS—AND FIELD TESTED "BY THE CARLOAD."

HUBBARD AND COMPANY

PITTSBURGH OAKLAND CALIFORNIA CHICAGO

"HANG THE LOAD ON HUBBARD HARDWARE"

MASTER CRAFTSMEN LIKE CHARLEY★

CREATE MASTER-LIGHTS

Type T MASTER-LIGHT Utilities' Preference in an Automobile Searchlight

★ Charley—with us 20 years — is an artist in metal. Those strong, knowing fingers can perform near miracles with tools! Consummate craftsmen like Charley are major factors behind MASTER-LIGHTS' high quality.

There's a reason why over 500 U. S. Public Utilities choose MASTER-LIGHTS for their repair crews . . . Craftsmen create them. Each MASTER-LIGHT meets a HIGHER standard of performance than does *any* comparable competitive light . . . *"Quality-Built"* sums it up.

A MASTER-LIGHT For Every Need

Many satisfied utility customers have led us to specialize in manufacturing lights utilities need—both hand lights and automobile spotlights. Read the new MASTER-LIGHT catalog. In it, you'll find *high-powered, convenient* MASTER-LIGHTS that will help YOUR repair crews make better, faster night repairs. MASTER-LIGHTS are sent on approval. Write for free catalog now.

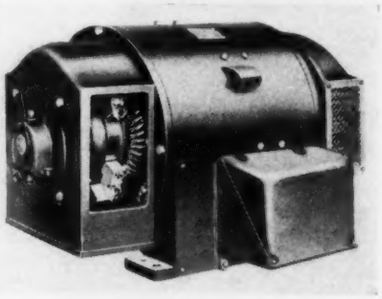
CARPENTER MFG. CO.
Manufacturers of MASTER-LIGHTS
214 Sidney Street, Cambridge, Mass.

Two styles are offered—both for direct lighting—a single- and a two-lamp unit. Both use 40-watt, 48-in. white or daylight fluorescent lamps, which are covered by ornamental "Alvax" glass ware.

•

D.C. Motors

Compactness and improved protection are claimed features of a new line of d.c. motors. Protection from external damage is provided by a new design of rolled-steel



Typical of d.c. motors of larger ratings, beginning at 50 hp., 850 r.p.m.; open motors offered in constant-speed ratings from ½ hp. at 850 r.p.m. to 60 hp. at 1,750 r.p.m., in adjustable-speed ratings from ½ hp. at 850/3,400 r.p.m. to 15 hp. at 500/1,800 r.p.m. **General Electric Co.**, Schenectady, N. Y.

frame and improvements in end-shield and bearing-bracket construction. "Formex" wire coils and "Glyptal" insulating varnish are used to give high resistance to impact, abrasion and action of foreign materials. Motors are offered with sleeve or ball bearings. Larger motors embody a new system of self-ventilation.

•

Geared Motors

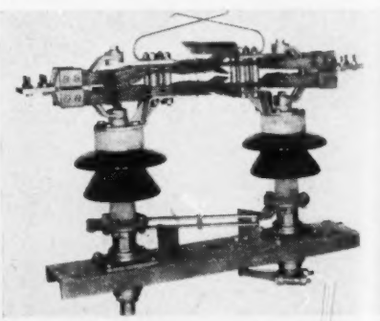
Two-speed geared motor; in speeds from 700 to 8,000 r.p.m. and sizes from ¼ to 3 hp. for polyphase circuits only. **Walker-Turner Co., Inc.**, Plainfield, N. J.

At the pressure of a button, an operator may have either of two speeds from this geared motor, now provided with a double winding and an interlocking switch.

•

Switch

Where space factor is important, two-insulator, horizontal centerbreak switches can be advantageous for group switches. Over-all length is less than for three-insulator types, and the shorter blade permits closer phase spacing than two-insu-



Type "PM-22," 23-kv. 2,000-amp. switch. **Delta-Star Electric Co.**, Chicago, Ill.

Only Moloney Transformers

PROVIDE *all* OF THESE FEATURES

Brass cap nuts protect stud threads.

Ratio adjusters are supplied at no extra cost, on transformers on which taps are standard.

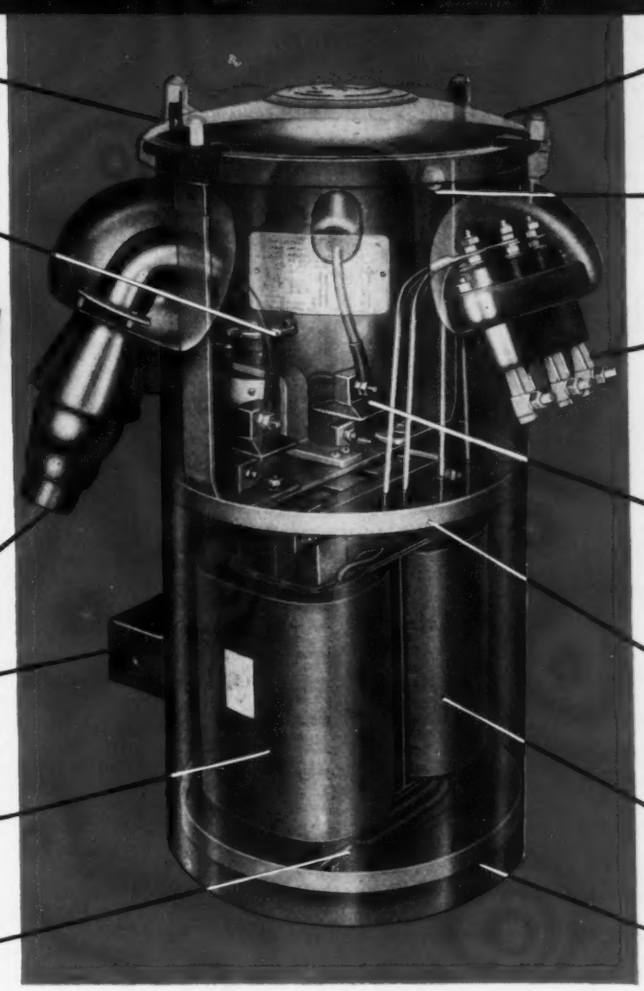
Solderless connector type high voltage bushings available up to 15,000 volts.

Insulating caps provided at no additional cost.

Hanger bracket permits mounting directly to pole. No hanger irons or special plates are required.

"Surge-Proven" core-and-coil unit reduces outages resulting from surges.

Fabricated steel core clamping structure.



Pressed steel cover of heavy gauge stock.

Core-and-coil unit anchored to tank above oil level.

Positive-grip solderless connectors of high tensile strength copper alloy. Neutral is gapped to ground.

Disconnects are provided in the high voltage leads to permit easy removal of bushings or core-and-coil unit.

Circular steel band protects leads and ratio adjustor, and centers unit in tank.

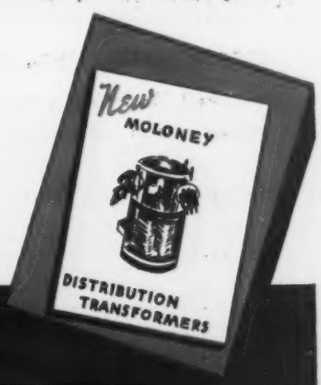
Core type construction permits easy replacement of coils.

Transformer is shipped filled with proper quantity of oil.

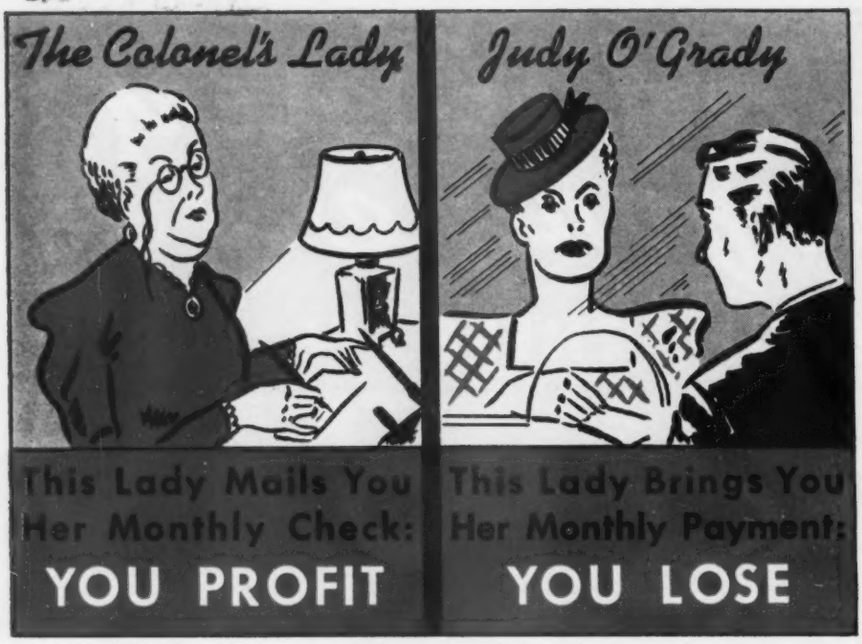
Write for Bulletin D-390222

Real Value for Your Transformer Dollar

On no other transformer will you find so many features. Compare Moloney transformers with those of any other manufacture. Compare them feature for feature . . . compare their operating records. You'll discover that you get more value for your transformer dollar when you buy Moloney transformers.



MOLONEY ELECTRIC CO.
ST. LOUIS MISSOURI


The Colonel's Lady
Judy O'Grady
This Lady Mails You Her Monthly Check: YOU PROFIT
This Lady Brings You Her Monthly Payment: YOU LOSE

• "Well," you say, "we can't make money on all of them." True enough. Chances are it's costing you about $1.50 a month average to serve each of your lighting customers. A large group of low-income-families will have bills under $1.50

Just how big does that percentage of unprofitable customers need to be? Perhaps it should be reduced. It's a fact that *many low-income families want to cook electrically*—and some are in the market for new ranges right now!

Electromaster's policy is concentrated on one purpose: *to make the low-income "Judy O'Grady" a profit-customer for her Electric Utility* . . . Would you like to know about the Electromaster plan? We'd like to tell you . . . Use the coupon!

(For Electric Utility Executives Only, Please)

ELECTROMASTER, INC., 1803 E. Atwater St., Detroit, Michigan

Yes, we'd like to look over this plan—particularly your proofs that it works. This request puts us under no obligation.

Utility .....

By .....

Title .....

Address .....

lator single horizontal break switches with blade full length between insulators. In the illustrated switch both blade portions open on the same side of the channel base, causing a combined shearing and twisting action for breaking ice or corrosion.

•

Protective Lighting

Designed especially for those industrial plants where tower truck maintenance equipment is not available, this protective lighting unit assembly consists of a modern high-intensity luminaire mounted on a tapered steel "Monotube" pole. Luminaire is equipped with a disconnecting orientating cutout which permits it to be lowered for relamping, cleaning, etc.

Protective lighting unit. **The Union Metal Mfg. Co.**, Canton, Ohio.

•

Fixture Finishes

Fostoria Pressed Steel Corp., Fostoria, Ohio.

This company now offers its entire line of fluorescent and silver-bowl lighting units in a variety of ten different colors for the outside finish: hammered gray, tan or green; gloss white, ivory, gray or green; wrinkle gray, black or brown. According to the company, this feature is made possible through the use of the near infrared process for baking the finishes on the lighting units.

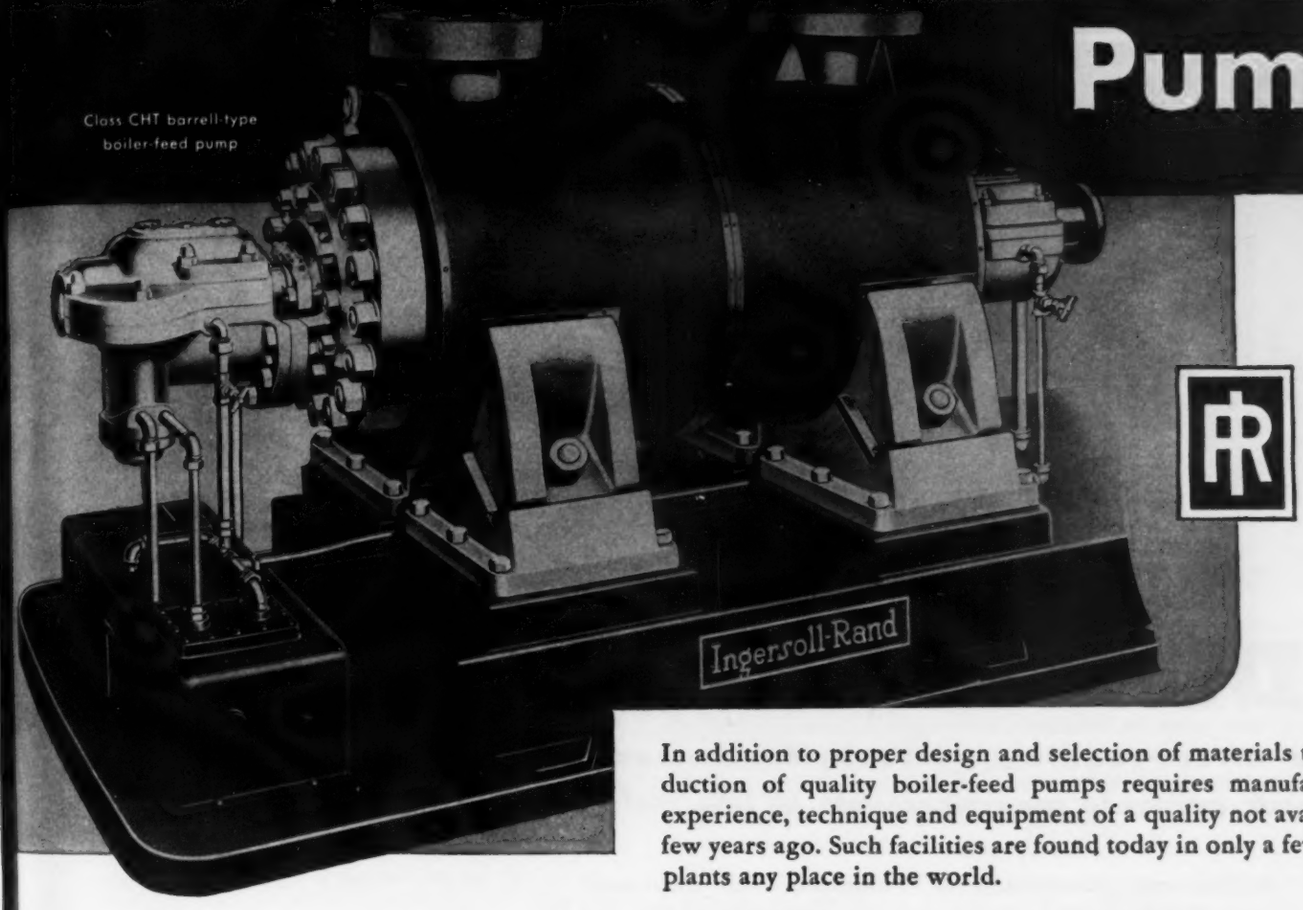
•

Paging Device

With this "code-sending" station, one to twenty individuals may be located. Numbers are assigned to persons most frequently wanted, the unit is then dialed to the party

"Pager". **The Autocall Co.**, Shelby, Ohio.

Only a Modern Plant Can *build a* Modern Boiler Feed Pump



Class CHT barrell-type boiler-feed pump

In addition to proper design and selection of materials the production of quality boiler-feed pumps requires manufacturing experience, technique and equipment of a quality not available a few years ago. Such facilities are found today in only a few pump plants any place in the world.

- Ingersoll-Rand's Cameron plant is devoted exclusively to the manufacture of pumps. All machine tool equipment is modern and selected for handling the corrosion and wear-resisting materials now widely used in pumps. Many of the machines are special purpose units designed for a specific operation on a pump part. The tool and conveyor equipment in the Cameron plant represents an investment of well over a million dollars.

Modern pump manufacture requires a proper sequence of operation on any piece, strict interchangeability of duplicate parts, tolerances on many dimensions of .001 in. and less, and rigid inspection at all stages of the work.

Ingersoll-Rand has the equipment, personnel and experience to maintain such standards. Stock is available to assure you of immediate field replacement of all standard and many special parts.

I-R Cameron boiler-feed pumps are more efficient and will last longer because of the modern equipment and precision methods employed in their manufacture.

Dallas
Denver
Detroit
Duluth
El Paso
Hartford
Houston
Kansas City

Ingersoll-Rand

Cameron Pump Division

11 BROADWAY, NEW YORK, N.Y.

761-10

Knoxville
Los Angeles
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New York
Philadelphia
Picher
Pittsburgh
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Salt Lake City
San Francisco
Scranton
Seattle
St. Louis
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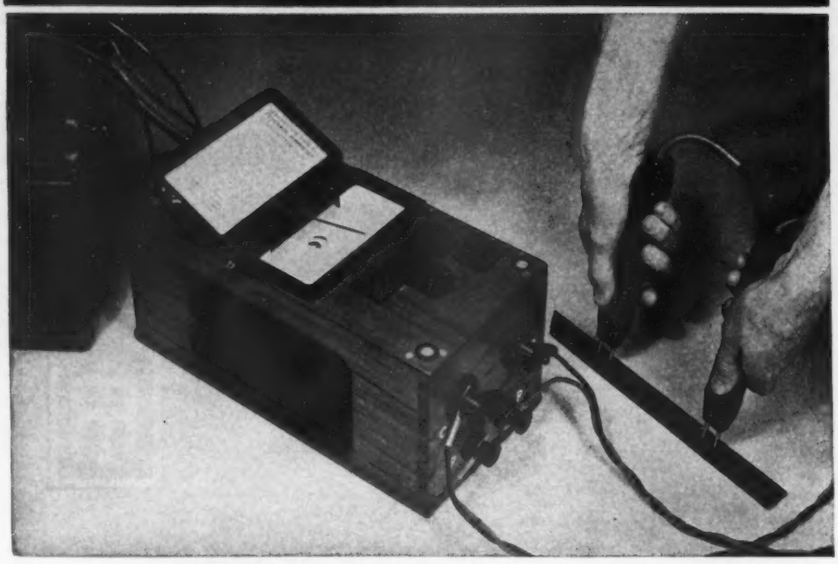
Washington

Measures
Switch and Circuit Breaker Contacts
down to .000001 ohm



"DUCTER" LOW RESISTANCE OHMMETER

—a direct-reading portable instrument for quick accurate measurements of low resistance

Without any adjustments or "balancing", this instrument gives direct pointer indications of resistance down to one *millionth of an ohm!* Simple, rapid, accurate and reliable for measuring armature, field and transformer coils, soldered joints, fuses, switch and relay contacts, and other low resistances. Saves time, trouble and calculations. A unique member of our famous "Megger" family of resistance-measuring instruments.

Detects Trouble in Oil Switches and Circuit Breakers

By supplementing your visual inspection of oil switches and oil circuit breakers with this dependable measurement of contact resistance, you can detect incipient troubles with certainty. Oxidized and pitted contacts, weak springs and contaminated oil are apt to raise contact resistances to points where an increased load causes real trouble. Simply open the disconnects, close the switch, apply the "Ducter" test leads and read the scale.

"MEGGER"

For further particulars, please write for descriptive Bulletin 1635-W.

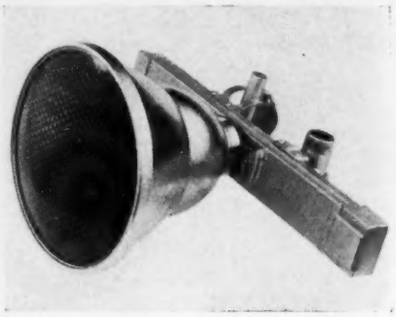
James G. Biddle Co.
1211-13 ARCH STREET *Electrical and Scientific Instruments* PHILADELPHIA, PA.

wanted, transmitting signals—chimes, bells or gongs—to all departments on the premises.

•

Infra-Red Lamps

Through the use of the "sealed-beam" construction, improved energy control, glare elimination and reduced maintenance cost are said to be achieved in a new "infra-red" lamp for radiant heating. Reflecting surface of the lamp body is



"Thermalamp;" in ½ and 1 kw. sizes; available in "custom-built" ovens. C. M. Hall Lamp Co., Detroit, Mich.

gold-plated. Covering the prefocused 4,000 deg. filament is a lens of newly developed glass for heat transmission. This company has also recently announced new diamond-backed open reflectors in 9- and 12-in. sizes.

•

TECHNICAL LITERATURE

HOUSEHOLD RANGES—Test specifications for household electric ranges, as reported jointly by the Edison Electric Institute and the National Electrical Manufacturers Association are listed in a new ten-page bulletin. Copies of the E.E.I. Publication No. H1, or of the N.E.M.A. Publication No. 108 may be secured from E.E.I. at 420 Lexington Ave., of N.E.M.A. at 155 East 44th St., New York, N. Y., at 50 cents a copy (non-members in the U. S. A.).

CROSSARMS—Suggestions for specifications for type A untreated Douglas fir crossarms, as approved by the transmission and distribution committee of the Edison Electric Institute are available as an eight-page booklet, "TD-61," from E. E. I. headquarters, 420 Lexington Ave., New York, N. Y.

PLANT PROTECTION—In a brief four-page pamphlet various pertinent check questions are listed as an aid to the owner considering plant protection. Copies of the publication "Planned Protection," may be secured from Graybar Electric Co., Inc., Graybar Bldg., New York, N. Y.

TEMPERATURE MEASUREMENTS—Written for those concerned with the operation of generators, synchronous condensers, frequency changers, large motors, transformers and cables, a new 32-page publication shows how knowledge of operating temperatures (1) enables operators to act promptly to protect units from overheating and (2) provides a guide for maximum safe loading. Company's line of recorders is described. To get a copy, ask Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa., for Catalog N-33-161.

MANUFACTURING - MARKETS

G.E. Employees Get $8,000,000 Bonus

For the year 1940 a total of approximately $8.000,000 will be added to the regular earnings of about 66,000 General Electric employees who are eligible to participate under the company's general profit sharing and cost-of-living adjustment plan, according to President Charles E. Wilson. The total in 1939 was $5,019,000.

Based upon an estimate of the company's net income for 1940, about $4,500,000 will be available to employees as general profit sharing and they will receive an additional $3,500,000 as a cost-of-living adjustment. Corresponding amounts in 1939 were $2,566,000 and $2,453,000.

Regular earnings of eligible employees with five or more years of service will be increased about 7 per cent as a result of the operation of these two plans, compared with about 5 per cent last year.

Mr. Wilson said that the company now employs about 82,000, or 15,000 more than a year ago, not including employees of affiliated companies.

•

Manufacturers Vote Common Dividends

Directors of General Electric Co. have declared a dividend of 80 cents a share, payable December 20 to holders of record November 22. This brings payments for the year to $1.85 a share, compared with $1.40 in 1939.

Cutler-Hammer, Inc., declared a dividend of 50 cents a share on the common stock, bringing payments for this year to $1.50 or twice the amount distributed in 1939.

Colt's Patent Fire Arms Manufacturing Co. voted the regular quarterly dividend of 50 cents a share and an extra dividend of $3 a share, payable December 21, to stockholders of record December 2. This brings payments to $6 a share for the current year. Directors also voted extra compensation of 6½ per cent to all the 4,300 employees on the basis of their 1940 earnings. Earlier in the year the company paid employees 7 per cent on earnings for the first six months, an increase for the year of 10 per cent. The average extra compensation to employees is 3 per cent greater than a year ago, when only 2,350 were employed.

Johns-Manville directors have declared a dividend of $1.25 per share on the common stock, payable December 24 to holders of record December 10. This compares with 75 cents paid on September 24 and on June 24 last.

•

Lighting Fixture Makers Show 8% Production Gain

Lighting fixtures manufactured by this industry in 1939 had a value of $124,581,725, as compared with $115,096,464 in 1937, a gain of 8.2 per cent, according to the Bureau of the Census.

Under the residential classification of fixtures, portable lamps represent the largest production, amounting to $25,780,800 in 1939, as compared with $23,301,204 in 1937. Leading the commercial fixtures group were public building, bank, store, office building and school, which increased to $8,468,738 in 1939 from $6,199,615 in 1937. Factory lighting fixtures led the industrial classification, with products valued at $2,737,413 last year, as against $2,019,972 in 1937.

•

Let Switchgear Contract

Water and Light Commission, Wisconsin Rapids, Wis., has awarded a contract to the Westinghouse Electric & Manufacturing Co. at $54,798 for switchgear for installation in new power substation.

Colt's Shows Increase in Electrical Orders

Rumors intimating that activities of the electrical division of Colt's Patent Fire Arms Manufacturing Co., Hartford, are being given up or set aside at present on behalf of production of firearms have been denied by Dwight G. Phelps, vice-president.

Mr. Phelps said that the company is expanding firearms facilities to the greatest extent possible in the national defense program. He said that a substantial amount of space used by the electrical division was made available to firearms when the electrical division was moved to a building isolated from the firearms plant.

Advantage was taken of the move to provide many new facilities for the very active and growing electrical division, with the result that since its establishment in its new location its productive capacity established a new high in September, and October was even higher. Mr. Phelps pointed out that the company has made a substantial investment in its electrical division and will not lessen its efforts to increase the number of electrical products. Vigorous development and production are to be anticipated in all non-firearms departments, including plastics and Autosan dishwashing machine divisions.

•

Appliance Manufacturers Report Production Gain

Manufacturers of electrical appliances showed a 12.5 per cent increase in production in 1939 as compared with 1937, with products valued at $145,696,194, as against $129,514,525, according to preliminary figures of the Census of Manufactures released by the Department of Commerce.

In 1939 there were 138 establishments, or 29.0 per cent more than in 1937, which employed an average of

19,890 wage earners during the year, or 3.5 per cent fewer than in 1937. Wages in 1939 amounted to $58,081,360, or 1.0 per cent less than in 1937.

•

Manufacturers Issue Earnings Reports

Weston Electrical Instrument Corp. reports for the nine months ended September a consolidated net profit of $574,288 after depreciation, federal income and excess profits taxes and other charges.

Profit was equivalent to $3.57 each on the 160,583 shares of common stock. For the first nine months of 1939 the net profit was $317,296, equal, after $34,197 dividends paid on class A stock and under participating provisions, to $2.43 each on 13,642 shares of no par class A stock and $1.68 each on 160,583 shares of common stock then outstanding.

Among the other manufacturers recently issuing profits statements are the following:

EMERSON ELECTRIC MANUFACTURING — Year to September 30, profit before income taxes, $171,174; after deducting $32,435 provision for estimated income taxes, net income for year was $138,739, equal after preferred dividends to 20 cents each on 387,770 shares of common stock. Net income in preceding year was $17,772, or $2.01 a share, on 8,831 shares of 7 per cent preferred stock.

CONTINENTAL-DIAMOND FIBRE — Including domestic subsidiaries, nine months ended September 30, net profit, $331,556, compared with $49,496 net profit last year; sales less returns and allowances, $4,259,865, against $4,068,089. September quarter, net profit, $84,086, against $22,607 in same quarter of 1939; net sales, $1,408,157, against $1,356,334.

•

Plans to Retire Shares

Directors of the Johns-Manville Corp. have voted to retire on January 1, next, 17,500 shares of the 7 per cent cumulative preferred stock at $120 each, plus accrued dividends, according to Lewis H. Brown, president. This would reduce preferred shares outstanding to 50,000. On January 15, last, the board voted to retire 7,500 shares of the preferred stock.

New York Metal Prices

	Nov. 26, '40 Cents per Pound	Nov. 19, '40 Cents per Pound
Copper, electrolytic	12.00*	12.00*
Lead, A. S. & R. Price	5.80	5.80
Antimony	14.00	14.00
Nickel, Ingot	35.00	35.00
Zinc, Spot	7.64	7.64
Tin, Straits	50.25	50.375
Aluminum, 99 Per cent.	17.00	17.00

* Delivery Connecticut Valley.

Field Reports on Business

Electrical equipment orders from industrials and utilities continue to flow in good volume. Demands for wage increases are becoming more vocal. Integration and new financing requirements loom as big utility problems to be faced next. Headway is being made on 1941 construction budgets.

PACIFIC COAST

Alongside the large quantities of inside wiring and outside line construction staple items needed for the scattered camps, fields and naval stations, there is an unusually heavy demand for line material for extensions in areas not directly affected by national defense considerations. Pacific Gas & Electric Co. is expending one million dollars in rural extension work, particularly in the counties of northern California. Clement weather has enabled work to continue beyond seasonal limits. Preliminary work has begun on this company's 28,000-kw., $3,780,000 hydro power plant at Dutch Flat, in Nevada County, east central California.

Bonneville plant extensions cover a 115-kv. transmission line, costing $248,989, to The Dalles; $135,789 for 82 miles of 115-kv. wood-pole line to Astoria, and a planned 183-mile, 230-kv. line requiring 898 steel towers in the Covington sector. Burbank, in southern California, is buying a 10,000-kw. turbine for its municipal plant. Power apparatus predominates in recent purchasing. Outstanding orders include six 25,000-kva. Allis-Chalmers transformers, value $61,200, for Los Angeles; five 40-ton electric locomotive cranes, value $130,305, for Mare Island; 600,000 ft. cable for Bonneville system; four 16,667-kva. G. E. transformers for East Nicolaus substation of P.G.&E. and a $50,000 turbine equipment for Union Oil Co.

Northern California reports 1,155 electric ironers sold during a September special campaign, an increase of 120 per cent over September, 1939. Pacific Coast table appliance stocks are rapidly diminishing and many staple numbers will be sold out early in December.

CHICAGO

The heavy volume of orders for a wide variety of electrical equipment reflects the high level of business activity throughout the Middle West. The greatest demand, of course, is for industrial apparatus, but other lines are coming up rapidly as substantial gains are spreading in an ever widening circle. Industrial companies in this area during the last month have authorized expansion of plants and facilities at an aggregate cost of over $10,000,000.

Electric power output increased 4,700,000 kw.-hr. over the previous week to a level 11 per cent above a year ago. Steel mill operations continue at over 99 per cent capacity and retail trade is booming throughout the district as a result of increased employment and payrolls. Department store sales last week rose 27 per cent over last year at this time and a record holiday buying season is anticipated. Nearly 3,000 new lights are to be installed on 57 miles of streets at a cost of $407,757. General Electric Co. is installing 980 circuits, 3,145 lights, 341 receptacles and 175 motors totaling 1,033 hp. in its new office building. The City Department of Public Works has requested bids on four 1½-ton electric cranes.

Activity in the defense program is bringing considerable business to the electrical industry in this area. Among the orders placed last week were: Motors, $59,381; electric crane, $10,500, and transformers, $12,920. Contract was awarded for a new Diesel-electric generating station at the Savanna, Ill. ordnance depot at a cost of $238,383.

NEW ENGLAND

Inquiries for electrical equipment and the booking of orders continue unabated in this district. Interest among manufacturers here is centered on additions to power generating capacity and extensions to distribution systems. Connecticut Light & Power will build about 50 miles of transmission lines in 1941. Extensive substation improvements and new service buildings will shortly have been completed on this system, including a 15,000-kva. synchronous condenser for Waterbury. Central Maine Power will immediately begin construction of a 27,000-hp. steam-generating plant, the major equipment having been ordered last summer to insure earlier installation.

Electric cable manufacturers are very busy; the city of Boston recently purchased 1,370 ft. of 600-volt cable. Bangor Hydro-Electric has completed laying 5,500 ft. of 5,000-volt line. Last week 20 miles of rural line located in western Addison county, Vermont, were put into service. Contracts involving more than $40,000 in floodlighting for the Quonsett, R. I., airport have been awarded and are now under way. A $5,000,000 base for housing and servicing non-rigid aircraft as part of the naval air expansion program is being planned for construction in the vicinity of Boston.

Arlington, Mass., has equipped its fire stations with electric ranges and refrigerators.

NEW YORK

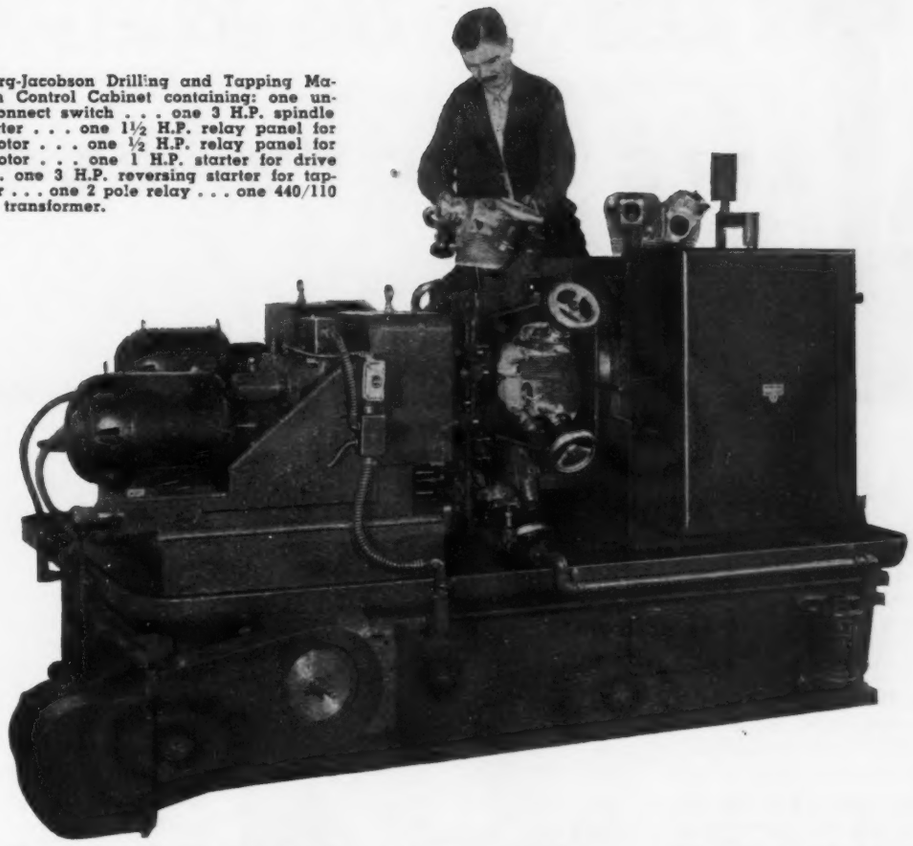
Construction contracts awarded in metropolitan New York and New Jersey during October showed a moderate increase over a year ago. Prospects are for a sizable increase as national defense program expands.

White House conferences on the 1941 tax program presage higher levies in many respects and a broader base. Taxes will take a greater percentage of profits, although the higher volume of business is likely to push net higher. Demands for wage increases are becoming more insistent as labor seeks a greater share in the defense prosperity. Thought is being given to bonus plans in lieu of wage increases. Profit effect on present defense orders now in production will soon show in reports when delivery schedules are stepped up. Some predictions are that lower unit profit will be next pressure demand.

A wide variety of electrical equipment is being ordered by industrial and utility customers. Utility construction outlook is clouded by pressure of integration, uncertainty over government's future power policies and SEC demands on method and kinds of security issues. A great deal of new money will be needed by utilities to meet construction budget demands.

Business in Pittsburgh area moved slightly higher last week, according to Bureau of Business Research, University of Pittsburgh.

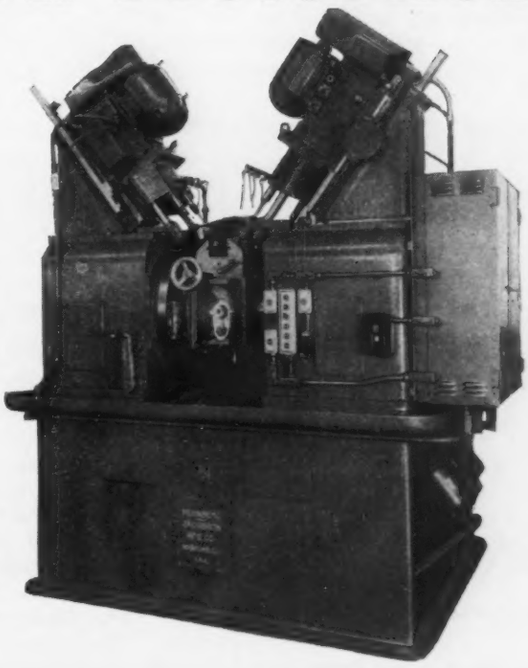
A Rehnberg-Jacobson Drilling and Tapping Machine with Control Cabinet containing: one unfused disconnect switch . . . one 3 H.P. spindle motor starter . . . one 1½ H.P. relay panel for spindle motor . . . one ½ H.P. relay panel for coolant motor . . . one 1 H.P. starter for drive motor . . . one 3 H.P. reversing starter for tapping motor . . . one 2 pole relay . . . one 440/110 Volt pilot transformer.



PROTECTION for the Machines Now Building OUR Protection

Machine tools by the thousands are being requisitioned for the vast armament program now under way—the finest, fastest tools ever built. And in this all-important undertaking production schedules will depend in a large part on the operating reliability of electrically driven machinery, which in turn depends on the reliability of motor control . . . Starting . . . Stopping . . . Reversing . . . Accelerating . . . Decelerating . . . Cutting out in case of dangerous overload . . . All these functions are cared for directly by Monitor controllers, leaving the operator free to devote his skill where most needed—where tool meets work.

Glad to consult with you to determine the most efficient and economical controller for your equipment . . . Write us today.



Another Rehnberg-Jacobson Drilling and Tapping Machine whose Monitor Control Cabinet contains: one unfused disconnect switch . . . four 2 H.P. magnetic starters for drill motors . . . two 2 H.P. reversing starters for tapping motors . . . one 6 pole relay . . . one 4 pole relay . . . two 2 pole relays . . . one pilot transformer 440/110 volts.

TheMonitorControllerCompany

GAY, LOMBARD & FREDERICK STS. BALTIMORE, MARYLAND

NEWS ABOUT PEOPLE

Coolidge and Crocker New G.E. Vice-Presidents

Dr. W. D. Coolidge, who was recently appointed a vice-president of the General Electric Co. (ELECTRICAL WORLD, November 23, page 10), has been a member of the research laboratory staff since 1905 and director since 1932. He is a member of the National Inventors' Council recently created to encourage civilian inventions as part of the national defense program.

A graduate of the Massachusetts Institute of Technology, Dr. Coolidge won his doctor's degree at the University of Leipzig, Germany, and joined the M.I.T. faculty, resigning an assistant professorship to join General Electric. He received the Rumford Medal for the invention and application of ductile tungsten and is one of the few men having the honorary degree of Doctor of Medicine, an honor accorded him

W. D. Coolidge

in 1937 by the University of Zurich for his x-ray work. His scientific honors include the Edison Medal of the A.I.E.E., the Faraday Medal, John Scott Award, Washington Medal of the Western Society of Engineers, Hughes

S. M. Crocker

Medal of the Royal Society, Louis Edward Levy Medal of the Franklin Institute, the gold medal of the American College of Radiology and the Howard N. Potts Medal.

Mr. Crocker has been manager of the air conditioning and commercial refrigeration department since May, 1939, and a vice-president of the International General Electric Co. since 1930. His career with General Electric dates from 1921 when, after work in the traffic and sales departments of the Radio Corp. of America, he became assistant to Owen D. Young, then chairman of the boards of both R.C.A. and General Electric.

He was elected vice-president and treasurer of the United Electric Securities Co., a General Electric subsidiary interested in foreign public utility financing. Twice Mr. Crocker accompanied Mr. Young to Europe, once to the conference which resulted in the Dawes plan and then for the reparations conference which formulated the Young plan.

In 1930 Mr. Crocker became identified with the International General Electric Co., resigning his position with United Electric Securities.

J. S. Bartlett Heads IAEL; Other Officers Elected

J. S. Bartlett, managing director, Electric Institute of Washington, D. C., was elected president of the International Association of Electrical Leagues for 1941 at the fifth annual conference which was held at the Palmer House, Chicago, recently.

Carl H. Christine, secretary-manager, St. Louis Electrical Board of Trade, St. Louis, Mo., was elected vice-president and John A. Morrison, managing director, Electrical Association of Philadelphia, treasurer. O. C. Small and J. F. Biggi were reappointed secretary and assistant secretary respectively.

Following the World War, Mr. Bartlett entered the insurance field in Milwaukee and became active in the local advertising club. Leaving the insurance field he established an advertising and

Washington Press-Photo Bureau

merchandising counselor service for retailers. In 1927, he was chosen to organize and manage the Electric League of Milwaukee and after something over two years in this work was selected to direct the National Red Seal Plan of Wiring for the Society for Electrical

ORANGEBURG HAS *long* BEEN PART OF

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Buried below Omaha's busy streets, Orangeburg has served this growing metropolis long—and well.

For during decades of service, this "preferred" conduit has provided *complete* cable protection—reduced cable maintenance to a minimum.

There is no mystery to Orangeburg's long life and complete cable protection. As this conduit is composed principally of coal-tar pitch, it is immune to corrosion—essentially everlasting.

Then—being chemically inert and neutral, this highly refined material cannot contribute to sheath corrosion in any way—and because Orangeburg absorbs less water than other types of conduit and has watertight joints, ground moistures, whether acid or alkaline, cannot penetrate the duct wall and affect the cable sheath.

Whatever your conditions, when you go underground, go Orangeburg. Thousands of distribution engineers have proved that when it comes to complete cable protection and lower installation costs, Orangeburg has no equal.

NOCRETE

For installation *without* concrete encasement: the Orangeburg dual-economy Nocrete conduit is recommended for service entrances, extensions, parkways and street lighting, suburban distribution, laterals, signal systems, etc.

STANDARD

For installation underground *with* concrete encasement: Orangeburg Standard Fibre conduit is recommended for duct banks (4 ducts and over), main distribution, high tension and "downstream" locations.

Sales Agent — Distributors

General Electric Supply Corp.

Graybar Electric Co., Inc.

MADE AT ORANGEBURG, NEW YORK BY THE FIBRE CONDUIT COMPANY, 292 MADISON AVE., NEW YORK CITY

ORANGEBURG NOCRETE for installation without concrete encasement
STANDARD for installation with concrete encasement

Development in New York. In this work he contacted many of the electric leagues throughout the country on both adequate wiring and in assisting in the development of promotional programs through local co-operative organizations. In 1933 Mr. Bartlett went to Washington to survey the field of electrical merchandising there. As a result of this study, the Electric Institute of Washington was organized, and Mr. Bartlett was selected as managing director. It was in Washington in 1936, that the present organization of the International Association of Electrical Leagues was completed.

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▶ JAMES D. LYNETT, supervising chief electrical inspector for New York City, was elected president of the eastern section of the International Association of Electrical Inspectors at the recent meeting in New York.

▶ R. A. TRAVISANO has been appointed traffic manager of the Worthington Pump & Machinery Corp. to succeed the late H. T. Smith.

▶ L. P. FESSENDEN, district manager of the Sheboygan offices of the Wisconsin Power & Light Co., will retire under the company's pension system on January 1, when he will be succeeded by PAUL H. FISCHER, at the present time manager of the utility's Berlin district. Oldest district manager of the company in point of service, Mr. Fessenden in May rounded out 50 years of service in the electric utility industry.

▶ DONALD G. LITTLE has been appointed consulting radio engineer and JOHN E. HUTCHESON as engineering manager of the radio division of the Westinghouse Electric & Manufacturing Co. Mr. Little had been chief engineer of the radio division since 1927 and his latest appointment was made so that his experience and knowledge may be best used in radio developments and engineering projects arising from Westinghouse national defense contracts. Mr. Hutcheson joined Westinghouse in 1926 and since then he has been a member of the radio engineering department at its various locations in East Pittsburgh, Pa., Springfield, Mass., and Baltimore, Md.

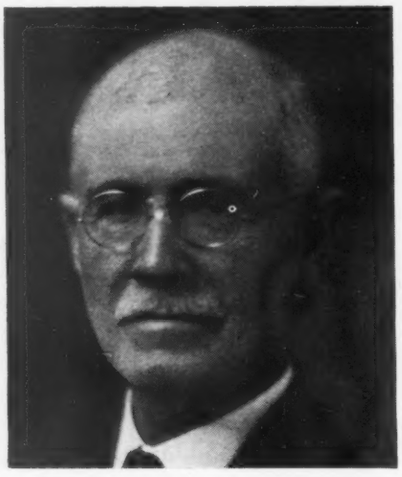
▶ C. E. HARRISON, vice-president of the American Engineering Co., Philadelphia, Pa., has been appointed general manager. He will have general supervision of the entire activities of the company in addition to his duties as vice-president. Mr. Harrison is a mechanical engineering graduate of the Carnegie Institute of Technology. He served in the U. S. Navy and first became associated with the American Engineering Co. in 1913 as a field inspector. In 1916, he became manager of the service department and remained in that capacity until 1936 when he was made works manager. He was elected to the vice-presidency in 1938. He has been granted 50 patents in the United States and foreign countries.

▶ W. C. BUCHANAN, president of Globe Steel Tubes Co., Milwaukee, was elected a member of the board of directors of Allis-Chalmers Manufacturing Co. at the latter company's board meeting in New York last week. Mr. Buchanan was named to fill one of two vacancies on the Allis-Chalmers board created by the death of Gen. Otto H. Falk, former board chairman, and of Oscar Gubelman, a director for many years.

OBITUARY

Capt. William P. Lay

Capt. William P. Lay, founder and first president of the Alabama Power Co., and a leader in industrial development in that state, died at his home in Gadsden November 21 at the age of 87.



It was due to the energy and foresight of Captain Lay that the Lock 12 project on the Coosa River was due, this dam marking the beginning of hydroelectric development in Alabama. On November 23, 1929, in the presence of prominent state officials and a large throng of citizens the project was the scene of a ceremony at which the name of "Lay Dam" was given to the structure. Last year more than 200 friends of Captain Lay gathered to honor him by placing on the dam structure a bronze tablet in recognition of his contributions to the progress and development of Alabama.

Captain Lay sold controlling interest in the utility some years ago. Born in Cherokee County, Ala., he entered the lumber business in Gadsden in 1870. He built and owned the first electric light plant in the community, and in 1898 organized the Coosa-Alabama Improvement Association to open the Coosa River to navigation from Rome, Ga., to Mobile, Ala. He was for many years vice-president of the National Rivers and Harbors Congress and vice-president of the Mississippi Valley Association for the southeastern division, and was chairman of the Alabama Conservation Commission for twelve years.

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Michael F. Millikan

Michael F. Millikan, vice-president and chief counsel of the American Gas & Electric Co., New York, died November 22 at his Oakhaven farm, near Easton, Md. Mr. Millikan was widely known in the public utility field. He had been ill for only a shart time. He was a brother of Dr. Robert A. Millikan, president of the California Institute of Technology.

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Homer V. Armstrong

Homer V. Armstrong, president of the Kentucky-Tennessee Light & Power Co., Bowling Green, Ky., died November 15 in a Terre Haute, Ind., hospital, in his fifty-ninth year. He had gone to Terre Haute two weeks prior to his death to consult physicians.

Mr. Armstrong had extensive experience in the public utility field. After finishing school, he went to work for the United Gas Improvement Co., spending part of the time in the head office in Philadelphia and the remainder of the time on the outside properties. After assignments at Sioux Falls, S. D.; Minneapolis, Minn., and in Conshohocken, Pa., he joined Northern Indiana Gas & Electric Co. as an engineer and later was appointed vice-president and general manager of the Michigan City division. After serving as vice-president and general manager of the Sioux Falls Gas Co., he went to Columbus, Ohio, as vice-president and group manager of Electric & Gas Utilities. In 1932 the office of Electric & Gas Utilities was moved to Terre Haute. Mr. Armstrong became president of Kentucky-Tennessee Light & Power Co. with headquarters in Bowling Green in 1939.

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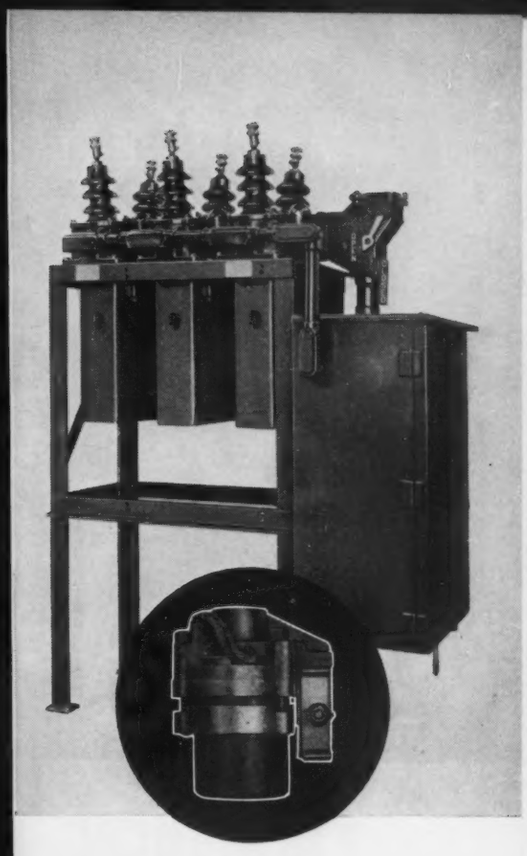
▶ G. H. BAGBY, manager of the Arkansas Power & Light Co. in Lake Village for the past 25 years, died November 16 from a heart attack while on a hunting trip. Mr. Bagby was 63 years old.

CIRCUIT BREAKER *insurance!*



RUPTORS ARE USED on this Type OZ-110, 600 ampere, 15 kv outdoor Oil Circuit Breaker with interrupting capacity of 100,000 kva, for greater efficiency.

Ruptors Extinguish Arcs FAST! Their "QUICK-QUENCH" Action CUTS Oil Carbonization and Contact Deterioration to a Minimum!

● Low cost insurance . . . pennies protecting thousands of dollars of investment . . . that's what you get when you install Allis-Chalmers Oil Circuit Breakers with Ruptors, in your high voltage systems.

For Ruptors extinguish arcs . . . *in split cycles!* Their "QUICK-QUENCH" action insures you against high maintenance costs. Contact replacements are reduced! Oil carbonization is cut to a minimum!

You're insured against high inspection costs, too. You get consistent operation without constant attention. Ruptors are easy to get at for inspection and maintenance. They don't waste the time of your maintenance men, as some other circuit breakers do. And Ruptors handle many more circuit breaker interruptions before they require inspection and renewal of oil or contacts.

More "Breaks" For Your Money! You get more than that when you specify Allis-Chalmers. All the benefits of Allis-Chalmers broad engineering experience are available to you. Tests and technical research in the laboratories of Allis-Chalmers and associated companies throughout the world are put to work to get you more "breaks" for your money.

Get the Whole Story on "QUICK-QUENCH" Action!

Find out about this low-cost insurance. Learn how "QUICK-QUENCH" action can give you higher interrupting capacities at a reduced premium in lowered maintenance costs. Let your Allis-Chalmers representative, in the district office near you, give you the whole story on "QUICK-QUENCH" protection!

936

SWITCHGEAR DIVISION

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

METALCLAD SWITCHGEAR • SWITCHBOARDS • OIL CIRCUIT BREAKERS • REGULATORS • MOTOR STARTERS • CUBICLES • SWITCH HOUSES

LOOK HERE FOR WAYS TO IMPROVE OPERATION

Power plant men are short-cutting to the correct answer to many a problem by making use of the readily available results of our wide experience in the use of instruments.

Below we list some publications available on request. If you need further information, let us know the details.

ALL L&N INSTRUMENTS for the power plant are described in a single large folder. Giving an overall picture of the equipment available, it covers both electrical and steam generation. All the different types of instruments are illustrated and described. A paragraph is devoted to the application of the instruments to each specific quantity to be measured or controlled. **BROADSIDE N-160.**

COMBUSTION CONTROL is covered in a 32-page catalog illustrating the application of Metermax to boiler furnaces of every major type. Schematic diagrams show how Metermax is applied. Reproductions of chart record illustrate the results actually being secured. **CATALOG N-01-163.**

FLOW measurements which are important enough to deserve a unique degree of accuracy can justify the installation of a Centrimax Flowmeter. **CATALOG N-28.**

TEMPERATURE measuring equipment for the steam is presented. Three methods are covered: thermocouple, resistance thermometer, and optical. Micromax indicators, recorders, controllers and accessories are described. **CATALOG N-33-163.**

PER CENT CO_2 IN FLUE GASES is measured by Micromax equipment operating on the saturated-gas, thermal-conductivity principle. Cell corrosion is eliminated and time lag is reduced, but most important of all is the fact that in many cases, maintenance is reduced to less than an hour a month. **CATALOG N-91-163.**

SMOKE DENSITY can be shown to operators so clearly that smoke abatement schedules can easily be followed. A continuous indication can be duplicated at any desired location. Signals automatically warn of changes. A continuous, hour-by-hour record is drawn for management. **CATALOG N-93.**

CONDENSATE PURITY is measured with Micromax Recorders which automatically draw chart records of condensate conditions and, if contamination occurs, actuate an alarm to warn operator or, in addition, operate a motorized valve to divert impure condensate to waste. Illustrations include typical applications, and an actual size reproduction of indicating scale and chart, in color. **CATALOG N-95-163.**

TEMPERATURES of generators, synchronous condensers, frequency changers, large motors, transformers and cables are recorded by Micromax instruments which furnish reliable guides to safe loading. **CATALOG N-33-161.**

FREQUENCY CONTROL for industrial and non-interconnected generating plants is now available in compact and relatively inexpensive equipment. Consisting of only three units, the Micromax Controller, a relay unit and a selector switch, the control is easily installed; operates reliably. **CATALOG N-56-161(1).**

FREQUENCY RECORDING equipment is described, and a discussion of considerations responsible for the increasing use of equipment for frequency measurement and for frequency-load control is included. Illustrations show modern installations. **CATALOG N-57-161.**

LOAD RECORDING, telemetering and totalizing will be covered by **CATALOG N-58-161,** now in preparation. We'll be glad to put your name on the list to receive a copy when it issues, and will in the meantime send **FOLDER N-58-161(2).**

LABORATORY and testing instruments for the power plant are briefly described and illustrated in a publication which also includes all other L&N instruments for research, teaching and testing. Included are standards, bridges, potentiometers, photometers, instruments for locating cable faults and for testing instrument transformers, deflection instruments, other meters and insulation. **CATALOG E.**

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pH of raw water, treated make-up and boiler water is being studied with Universal pH Indicators to determine whether any relation exists between pH and scaling, carry-over, corrosion, caustic embrittlement, etc. The instrument is described in **CATALOG E-96(1).**

Jrl Ad N-160(11)

LEEDS & NORTHRUP COMPANY, 4938 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Series Capacitors for Distribution Regulation

[*Continued from page 38*]

circuit after the series capacitor is put in. This may take the form of self-excitation of induction motors, hunting of synchronous machines, or of distortion due to saturation on excitation of relatively large transformers. It is difficult to anticipate all the conditions that may arise and it is sometimes difficult to correct the conditions when they develop. It must be borne in mind that canceling the positive reactance of the line with negative reactance of the capacitor is not exactly the same thing as taking the reactance out of the line by changing the spacing of the line or the construction of the line. It naturally follows that some unstable condition may arise under certain conditions.

Series capacitor applications should, therefore, be scrutinized carefully, particularly if any synchronous machines are present. Most of the applications that have been made are entirely successful and these unforeseen difficulties are rarely encountered. In one instance difficulties due to hunting with a synchronous machine were encountered several years after installation when a synchronous machine was added to the circuit and steps were necessary to stabilize the operation.

[A subsequent article in this series will discuss the protection and control of the series capacitor.—EDITORS.]

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Rural Contracts Recently Approved

Announcement has been made by the Rural Electrification Administration that among the construction contracts approved between October 28 and November 5 were the following:

ALABAMA — Clarke-Washington Electric Membership Corp., Jackson, J. A. Davidson, acting supt., and Gordon Persons and Co., Inc., Montgomery, Ala., engineer, contract to Oman Construction Co., Nashville, Tenn., for building 120 miles of line, 292 members; bid, $70,669.

ARKANSAS—C & L Rural Electric Co-operative Corp., Star City, Lynn Thomasson, supt., and Ray W. Chanaberry, Inc., 1001-5 Realty Bldg., Louisville, Ky., engineer, contract to Codell Construction Co., Clark County National Bank Bldg., Winchester, Ky., for building 62 miles of line, 127 members; bid, $33,855.

COLORADO—Grand Valley Rural Power Lines, Inc., Grand Junction, Colo., Ivan W. Patterson, supt., and Rocky Mountain Engineering Co., 1441 Welton St., Denver, Colo., engineer, contract to Ofstie Construction Co., Spring Valley, Wis., for building 90 miles of line, 237 members; bid, $69,305.

FLORIDA — Clay Electric Co-operative Assn., Inc., Keystone Heights, E. P. McLean Engineering Co., Commercial Bldg., Moultrie, Ga., engineer, contract to Ivy H. Smith, Jacksonville, for building 216 miles of line, 464 members; bid, $130,980.

GEORGIA — Amicalola Electric Membership Corp., Jasper, A. C. Moore, supt., and J. B. McCrary Engineering Corp., Atlanta, engineer, has awarded a contract to Leo T. Barber, Moultrie, for building 347 miles of line, 915 members; bid, $205,684.

ILLINOIS—Shelby Electric Co-operative, Shelbyville, Lester Boys, supt., and Stanley Engineering Co., Muscatine, Iowa, engineer, contract to J. H. Huntzinger & Co., Davenport, Iowa, 267 miles of line, 575 members; bid, $196,420.

IOWA—Marshall County Rural Electric Co-operative, Marshalltown, Harry H. Frey, supt., and Stanley Engineering Co., Muscatine, engineer, contract to Ferguson-Diehl Construction Co., Jefferson, 215 miles of line, 409 members; bid, $135,229.

KANSAS—Lyon County Electric Co-operative, Inc., Emporia, M. E. Turkle, supt., and C. H. Guernsey & Co., Cherokee, Okla., engineer, contract to Jack Palmer Construction Co., Trenton, Mo., 185 miles of line, 297 members; bid, $100,282.

MARYLAND—Choptake Co-operative, Inc., Denton, C. A. Sennett, supt., and B. O. Vannort, Commercial Bank Bldg., Charlotte, N. C., engineer, contract to Miller-Baxter, Inc., Indianapolis, Ind., 240 miles of line, 468 members; bid, $157,249.

MINNESOTA — Southwestern Minnesota Co-operative Electric, Pipestone, Leroy C. Sabie, supt., and Ellerbe & Co., St. Paul, engineer, contract to Megarry Brothers, St. Cloud, 253 miles of line, 424 members; bid, $142,185.

MISSISSIPPI — Coahoma Electric Power Assn., Clarksdade, G. T. Alexander, supt., and Bowman and Bowman, Box 518, Greenwood, Miss., engineer, contract to Sullivan, Long and Haggerty, Bessemer, Ala., 140 miles of line, 511 members; bid, $72,336.

Among the contracts let during October were the following:

IOWA—Buchanan County Rural Electric Co-operative, Independence, Alwin J. Tonn, supt., and A. W. Grubb, Vinton, engineer, contract to Sandberg and Johnston Construction Co., Hampton, Iowa, 132 miles of line, 283 members; bid $80,839.

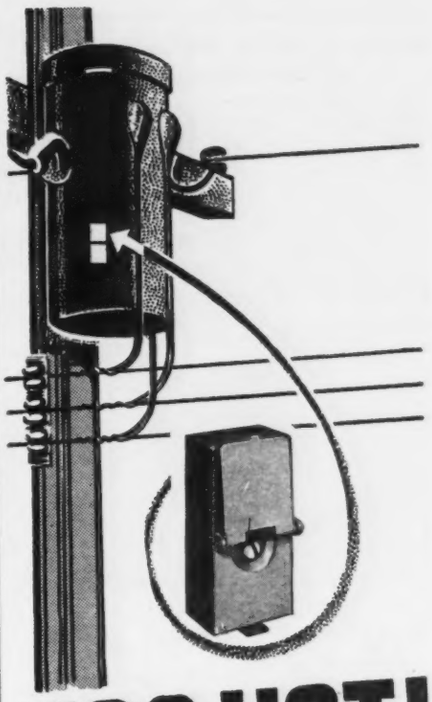
KANSAS—D. S. & O. Rural Electric Co-operative Assn., Inc., Solomon, Kans., Fred B. Atkins, supt., and Raymond H. Reed & Co., Abilene, Kans., engineer, contract to R. E. Mattison & Co., Britton, Okla., 187 miles of line, 307 members; bid $103,782.

MAINE—Kingman Electric Co., Kingman, Ivan L. Wyman, manager, and J. R. Worcester & Co., Boston, Mass., engineer, contract to Hugh L. Coleman, Great Barrington, Mass., 64 miles of line, 300 members; bid $71,585.

MICHIGAN—Top O'Michigan Rural Electric Co., Boyne City, Leroy Hardy, supt., and J & G Daverman Co., Grand Rapids, Mich., engineer, contract to Dutton Electrical Co., Inc., West Allis, Wis., 312 miles of line, 663 members; bid $197,601.

MISSISSIPPI — Southern Pine Electric Power Assn., Taylorsville, H. L. Pickering, supt., and Bowman and Bowman, Greenwood, Miss., engineer, contract to Delta Construction Co., Clarksdale, Miss., 527 miles of line, 2,150 members; bid $274,221.

MONTANA—Beartooth Electric Co-operative, Inc., Absarokee, J. H. Johnson, supt., and J. M. Garrison, State Water Conservation Board, Helena, engineer, contract to D. M. Manning, Hysham, Mont., 277 miles of line, 420 members; bid $239,448.



TOO HOT!

SAYS THE

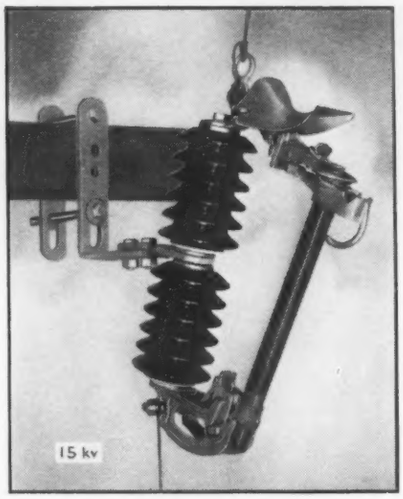
THERMALARM

To the inspector below that bright little flag up there indicates that at some time this particular transformer has been operating at a dangerously high temperature and needs investigating. Thermalarm is such a simple, inexpensive little device for such an important job, but it's fool-proof, accurate and will operate indefinitely. To attach Thermalarm just slap it against the side of your transformer where its permanent magnets hang on tight—no tools or straps required. Invisible when transformer is okay—a bright warning when case gets hot. . . . Write today for complete details.

EASTERN SPECIALTY CO.

3617 N. 8th St. Philadelphia, Pa.

DROPOUT FUSES WERE PIONEERED BY SOUTHERN STATES



Type 33 DROPOUT CUTOUT RENDERS *Dependable* PROTECTIVE SERVICE

Southern States' Type 33 Dropout Cutout offers one of the most dependable methods of protecting your expensive equipment and isolating trouble from the rest of your system.

The dependability of the "dropout" principle (which was originated by Southern States) is accepted by operating engineers as the most positive method of operation for protective fuses.

When the fuse link ruptures, the cartridge drops straight down and frees itself from the top latch, then swings to the fully open, fully indicating position.

The tube is open at both ends and allows gases created by the arc when the link blows to escape in opposite directions. Damaging shock and recoil that result from extremely heavy fault currents are thus eliminated.

The upper contacts are protected from sleet and ice formation by the sleet hood (notice in cut). Shearing action of the trunnions at the hinge end allow the cartridge to swing open under the most adverse conditions.

High pressure, solid copper contacts exert constant, even pressure which prevents overheating and radio interference.

Let us tell you more about the dependable Type 33 Dropout Cutout. Talk with a Southern States' representative or . . .

Write for Bulletin No. 178.

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Sales Opportunities

PASADENA, CALIF.—Municipal Light and Power Department has tentative plans under advisement for new steam-electric generating station to augment present municipal plant facilities. It will include turbine-generating units with capacity of 35,000-kw., high-pressure boilers and auxiliary equipment. Cost reported close to $2,000,000. Benjamin F. DeLanty is general manager.

LONG BEACH, CALIF.—Douglas Aircraft Co., Inc., 8000 Ocean Park Boulevard, Santa Monica, Calif., manufacturer of large military and other airplanes, plans installation of transformers and accessories, regulators, motors and controls, duct lines, interior industrial lighting equipment, exterior night-lighting facilities, interior communication system, conveyors, electric hoists, electric cranes and other equipment in new multi-unit plant near airport at Long Beach, to total about 1,422,000 sq.ft. of floor space. A complete air-conditioning system will be installed; a power station will be built. Entire project will cost about $11,000,000 and will be carried out in cooperation with government, which has awarded large contracts for military aircraft to company. Work will begin at early date, with completion scheduled during summer of 1941. Edward G. and Ellis W. Taylor, 803 West Third Street, Los Angeles, Calif., are architects and engineers.

KNOXVILLE, TENN.—Director of Purchases, Tennessee Valley Authority, Knoxville, receives bids until December 10 for 15-kv. metalclad switchgear for generating units Nos. 9 to 12, inclusive, at Wilson Dam hydroelectric power plant.

WAUSAU, WIS.—Wisconsin Public Service Corp., Milwaukee, plans call for bids early in February for new two-story and basement operating and office building at Fourth and Jefferson Streets, Wausau. Cost estimated about $100,000, with equipment. Oppenhamer & Obel, Wausau, are architects. (This project is included in 1941 budget of company).

BEAUMONT, TEX.—General Box Co., 500 North Dearborn Street, Chicago, Ill., plans a steam-electric power plant at new veneer mill on Hollywood Avenue, Beaumont, where tract of four acres of land has been secured. Also, will install motors and controls, duct lines, switchgear, industrial lighting system, conveyors, electric hoists and other equipment for mill service. Entire project reported to cost over $300,000.

WASHINGTON, D. C.—General Purchasing Officer, Panama Canal, Washington, receives bids until December 9 for two full automatic rectifiers, 12 induction-type relays, and 1,500 lineal feet of five-conductor control cable (Schedule 4563). Also, until December 11, for 20,000 lineal feet of bare copper wire (Schedule 4568).

JEWETT CITY, CONN.—Electric Light Commission plans new power substation on School Street, 32x60 ft., with L-extension, 32x34 ft., latter to be used for mechanical service, repair works, etc. Financing is being arranged through Federal aid. Haller Engineering Associates, 410 Asylum Street, Hartford, Conn., is engineer.

BROOKLYN, N. Y.—Bureau of Supplies and Accounts, Navy Department, Washington, D. C., receives bids until December 6 for quantity of electric cable for Brooklyn and Philadelphia, Pa., navy yards (Schedule 4175).

SAGINAW, MICH. — Saginaw Steering Gear Division, General Motors Corp., plans installation of motors and controls, duct lines, switchgear, industrial lighting facilities, conveyors, regulators, electric hoists and other equipment in new one-story addition, 360x660 ft. Cost reported over $500,000. Work will be placed under way soon.

SANDPOINT, IDAHO — Northern Idaho Rural Electrification Rehabilitation Association, Sandpoint, will take bids soon for new power line, about 35 miles long, using wood poles, to be used for distribution system at present time, with permanent construction to allow for conversion for 33,000-volt transmission line at later date, when power supply is available from new hydroelectric generating station to be built on Priest River, and to which point line will be extended at that time. Plans also are maturing for hydroelectric power project noted, for which bids are scheduled to be asked in 1941. John W. Cunningham & Associates, Spalding Building, Portland, Ore., are engineers for both projects.

BEVERLY HILLS, CALIF.—City Council plans installation of street-lighting system on all alleys in municipality, and estimates of cost will be made at once. W. R. Metz is city engineer, in charge.

DENVER, COLO.—Purchasing Agent, Bureau of Reclamation, Denver, receives bids until December 10 for 12 switch interlocks for 96-inch diameter paradox gate hoists; 24 mechanical locking unit interlocks for 84-inch diameter needle valves; 12 switch unit interlocks for 86-in. diameter paradox gate hoists, and 24 similar interlocks for 72-in. diameter paradox gate hoists (Specification E-23222-A-1).

FORT DIX, N. J.—Construction Quartermaster, Governors Island, New York, is completing plans for installation of an electrical distribution system at Fort Dix. Appropriation of about $51,000 has been arranged for work. Bids are scheduled to be asked soon.

BLOOMFIELD, N. J.—Walter Kidde & Co., Inc., West Street, manufacturer of fire extinguishers and kindred products, plans installation of motors and controls, regulators, duct lines, industrial lighting system, electric hoists, conveyors and other equipment in proposed one-story addition to plant for production of aircraft apparatus for government, for which contract is now being arranged. Work will be placed under way as soon as award has been consummated. Cost estimated close to $1,000,000, of which approximately $750,000 will be used for machinery and equipment purchases.

LIVINGSTON, MONT.—Emigrant Dredging Co., Emigrant, Mont., has approved plans for immediate construction of a 50,000-volt, three-phase transmission line from Livingston to point near Old Chico, vicinity of Emigrant, to be used for power supply for dredging and allied construction operations. A transformer station will be built at line terminus.

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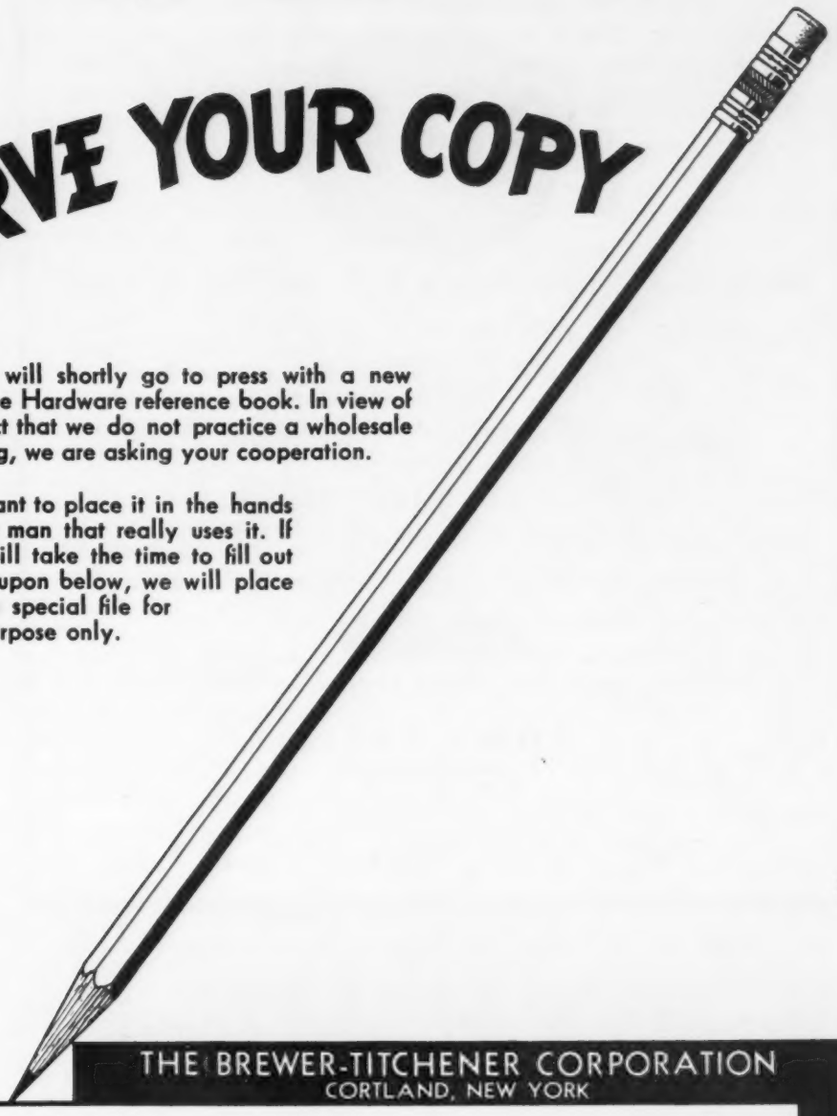

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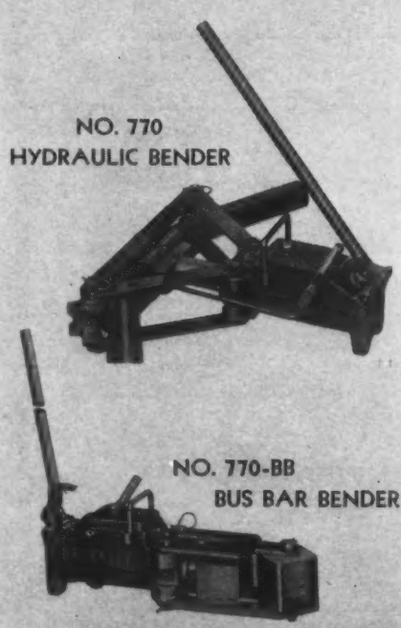

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LETTER TO THE EDITOR

Tetrachloroethylene Replaces Tetrachloride

To the Editor of ELECTRICAL WORLD:

On pages 82 and 83 of the October 19 issue of ELECTRICAL WORLD there is an article describing an apparatus for cleaning jewels, using carbon tetrachloride as the cleaning agent.

We have been using a compressed air arrangement somewhat similar to this, but have discontinued the use of carbon tetrachloride in favor of another chlorinated hydrocarbon called tetrachloroethylene.

There were two reasons for this change. One was that the latter does not leave any noticeable deposit when it dries and the other is that the Detroit Board of Health says that the toxic effects are much less in the case of tetrachloroethylene. They recognize 75 parts per million, or less, of carbon tetrachloride in air as being safe, while concentrations of 200 parts per million of tetrachloraethylene are considered satisfactory.

Also in the apparatus described there is a breather pipe extending 2 ft. above the apparatus to carry off the fumes. This, we think, defeats its own purpose because the fumes from all these chlorinated hydrocarbons are heavier than air and will come down past the operator's face. It would be better if arrangement were made to take these fumes away from the lower position, as, for example, by an exhaust fan, which would move a current of air across the table.

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Utility Act Can Be Made to Work

[*Continued from page 35*]

even for refinancing, their debt and capital conditions will have to be reset on a sound basis.

Extent of Reform

The need for extensive reform of organization and practice in the utility industry, I take it, no one denies. We are generally agreed that such practices as the *arbitrary write-up, over-capitalization, skimping on depreciation and otherwise using improper accounting methods can no longer be tolerated. It is likewise evident that the day of pyramiding corporate structures, extortionate service, management, and construction contracts with subsidiaries, and unjustifiable inequalities in the distribution of voting control is drawing to an end.* Our differences, as I see it, are not with the subject matter of reform, but rather with the manner and the extent of its achievement.

Co-operation Urged

To revert again to my banking analogy, here we are with a job of work to be done, under a statute that some of us consider too strict, others too lenient. But the job is urgent and the law is on the books. *Let's sit down with those charged with administering the law and work out programs for accomplishing as much of our job as we can in conscience under existing law.* I believe that this approach will work out many more of our differences than we now think possible. And if it develops that we cannot thus resolve all differences, then at least Congress and the responsible government officials will know that the difficulties which remain have not been exaggerated by the industry. Such co-operation between industry and government should quickly add to the effectiveness of both legislation and administration.

I have cited the success of the joint approach of our banking problems. I can assure you that as the result of our conferences the bankers got as much as they gave. There is no reason to believe that the approach would be any less fruitful to the utility industry. I feel certain that those charged with administering federal utility legislation are as well aware of the limitations of supervisory authority which I mentioned earlier as are bank supervisory authorities. The law is there and they must administer it, but they have no desire to embellish the law with extra-legal flourishes of their own, and if the law is wrong, they will be the first to want it corrected. They have clearly in mind the results the American people demand, but they are open-minded as to the best means of obtaining those results. They have a wide knowledge of the internal problems of the industry, but they don't pretend to have a panacea. They hope only to solve those problems to the best interest of consumers, investors and the general public. The philosophy with respect to the Utility Holding Company Act of 1935 has been well expressed by SEC Commissioner Healy:

Utility Act Philosophy

"For the future, the Holding Company Act means the end of corporate pyramiding in the electric and gas utility field, with its attendant speculation and unhealthy methods of control. It means, I hope, the end of improper accounting methods. It means no more write-ups and no more counterfeiting of values and earnings for stock-jobbing purposes. It means an end of the exploitation and victimization of operating companies. There will be no more private systems of inflation for the benefit of a self-appointed few. There will be no more upstream loans from operating companies to support their anaemic parents. There will be no extortionate service charges, representing, in effect, special dividends disguised as operating expenses. There should be no more milking of operating subsidiaries through inadequate provision for depreciation. There should be no more tricky securities. Voting power will be more equitably distributed. In reorganizations, the act means that there will be no more blackmailing of senior security holders by the junior interests who may own nothing but a power to vote. It means that government will have the right to say something as to the direction of the growth of national utility systems made up of corporations which are said to be devoted to the public service, which occupy public streets and highways and dam interstate and international rivers usually without paying for the privilege, which

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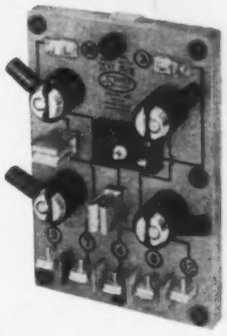

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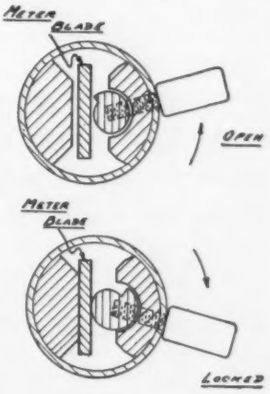

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through delegation to them of a portion of the state's sovereignty are permitted to condemn private property, and which owe their very existence to the indulgence of government.

"On the other hand, the Holding Company Act does not mean a death sentence for the utility industry or for the utility holding company. Nor does it mean value can be breathed into securities which it was unfair to issue in the first place. It does not mean that there is to be a dictatorship over the utility industry. It does not mean the nationalization of the utility industry. Whether you would oppose nationalization of electric power or whether you would favor it, you will not find it in the Holding Company Act, or in its administration.

"The act does mean lawful regulation in the interest of investors, consumers and the public, and a return to old-fashioned American conservatism and fair dealing from which we strayed in the roaring '20s. It recognizes and does not impede the earning of proper profits."

Is there anything there to which responsible utility management could object? Are not our aims and those of the Securities and Exchange Commission fundamentally identical? Is it not likely that a mutual understanding could be reached quickly and advantageously by two groups of reasonable men?

Good and Bad

Now if it appears that I am simply a propagandist for government agencies, let me quickly disabuse your minds. I am now and expect to be for many years a business man—the same as you. But I do know from experience that all is not evil and destructive in government, and I am rapidly learning from experience what I had long suspected—that all is not good and efficient and progressive in the field of utility management.

Common Sense Interpretation Needed

Let me say, too, that though I speak approvingly of the objectives of the Public Utility Holding Company Act of 1935, I am realistic enough to believe that *an open-minded attitude on the part of the government, as well as much common-sense interpretation, will be necessary* to make that act as useful to the public, to the utility industry and to the utility investor as I am certain it can be made.

I believe, for example, that *the integration provisions of Section 11 of the act will have to be administered with a fine sense of reason, balance and timing, and with the knowledge that the act is designed to prevent abuses in the future and to close avenues of abuse—not to turn back the pages of history.* I believe that the SEC, approached by the industry with any offer of co-operation in which it has confidence, shows that point of view. I believe that most holding companies can understand the benefits and the economies that will accrue from consolidation and simplification of their scope of operation, and that these companies will voluntarily accomplish much that is contemplated by Section 11. I consider it especially *important that the readjustment of properties among systems and any other disposal of properties be accomplished gradually and without any appearance of confiscation or sheriff's sale.*

Fictitious Control

I believe that encouragement of the management of operating companies by employee-directors is wrong in principle. Voting control of subsidiary companies by holding companies is admittedly wrong where the parent companies' financial control is largely fictitious. But where financial control is bona fide—whether in holding company or individual—actual control seems to be a prerequisite.

Service Companies

I recognize that service and management relationships in the past were frequently sources of serious abuse. But I cannot admit that all such relationships should be barred. *Properly constituted and properly supervised, service companies can contribute much to the economy and efficiency of operating companies.*

I believe that the purpose of the act would be better served if supervisory authorities possessed and exercised powers of visitation and examination over utility holding companies comparable to those now exercised by other agencies over banks. Periodic examinations of the affairs of holding companies for the infor-

mation of their directorates, as well as of the authorities, should contribute greatly to the mutuality of understanding that is so essential to sound and profitable operation.

Above all, I believe that these, and any other changes that can be justified in the light of the record and in the light of reason, are entirely possible of accomplishment. So long as there is a law I believe we all should work constantly to keep our operations within that law. Should certain phases of the law seem to be not in the best interest of the investors and the consumers we serve, we should attempt to obtain adjustments, consistent with the purpose of the law, that will permit us better to serve our trust.

Differences Can Be Reconciled

In the past there has been a tendency to exaggerate the differences between industry and government with respect to existing legislation. If we place greater emphasis upon the common objectives of government and industry and upon their points of agreement, I am convinced that the differences, seen in their proper perspective, could soon be reconciled, and that the purposes of government as well as the needs of the industry could be better served.

Fluorescent at Polaroid Plant

[*Continued from page 63*]

with the bottom of this. The reflection factor of the acoustic strip was 72 per cent, but this was not painted as there was a reading between the 10-ft. tube mounting centers of 16 ft.-candles.

The highest intensity of illumination provided is in the machine shop, where 35 ft.-candles was obtained. Elsewhere in the plant the management considered 16 to 28 ft.-candles sufficient for present needs. One condenser is provided in the plant for every seven fluorescent tubes, and the power-factor correction is such that more than 90 per cent is obtained. The grounded solid neutral system of distribution is provided at the cabinets with Bull Dog rotary type panels and switches connected to facilitate the use of both 115- and 230-volt service.

Typical small laboratories are 9.5x 15x11 ft., with four 40-watt fluorescents each mounted 7.5 ft. apart in two rows at the ceiling and symmetrically disposed. The machine shop requires 24 40-watt tubes on 7-ft. centers, mounted with Curtis strip at a cement ceiling, and giving an average intensity of 35 ft.-candles for a working volume of 40x20x11 ft. For the main office, 80x40x11 ft., 40 tubes were provided, supplemented by Polaroid desk fixtures.

Semi-Storage Air-Conditioning

[*Continued from page 65*]

tomer. But the energy consumption is not as much greater when comparing storage systems to "indirect" conventional systems using cold water as the transfer medium between the cooling coil and the evaporator instead of using the evaporator as the cooling coil. Ice-making jobs require greater consumption than straight cold-water storage jobs because of the reduced efficiencies of compressors operating at lower back pressures.

To the power company, of course, the advantages of storage systems are: Better load factor, off-peak operation, minimum demand during system peak and greater consumption per season. The one disadvantage seems to be the necessity of offering off-peak rate compensation.

It is possible that many power companies can offer off-peak rate compensation that will pay good returns on the added investment and extra owning costs involved in the storage system. This should be particularly true for power companies that experience daily system peaks of two to three hours duration in the summer months. It is possible that 95 per cent of the total consumption may be used during off-peak hours.

•

Vacuum Cleaner Sales Up

Vacuum Cleaner Manufacturers Association reports September industry sales of vacuum cleaners show an increase over the same month of the previous year of almost 15 per cent, with a total for the month of 138,923 units, as compared with 120,708 units for September of last year. The total for the nine months amounted to 1,275,412 units, as against 1,000,251 for the similar period of 1939, an increase of approximately 27 per cent.

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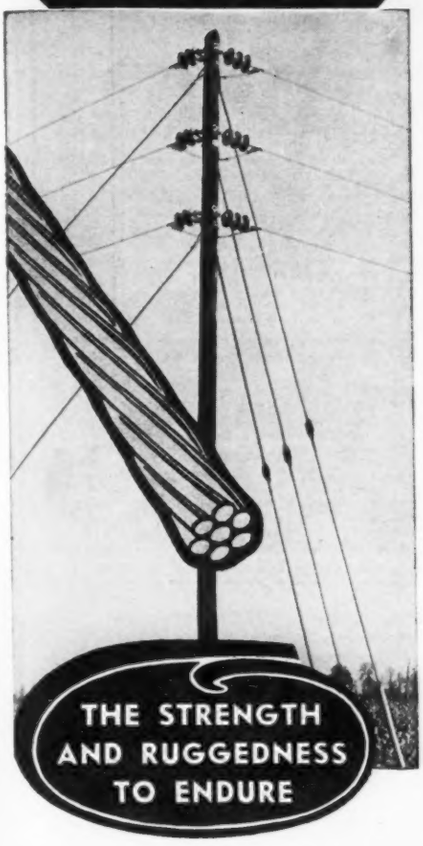

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[*Continued from page 67*]

weatherproof wire, plus portable cables. Number 12 B&S gauge was the smallest conductor used in wiring this farm. Circuit breakers were used to protect all wiring circuits, which seemed at first an unwarranted expense, but which proved to be worth while both from the standpoint of the farmer and the utility.

Where, for example, lighting or overload kicks out a breaker, the customer restores his own service. He does not have to locate a telephone, call us and then wait for an available trouble crew. Instead, he resumes his operations and we are saved the expense of a trouble call out in the country and our lost revenue total is reduced by prompt restoration of service. We should remember, too, that farmers seldom have spare fuses handy, neither can they step across the street to find a drug store open day and night which dispenses fuses.

Installed Equipment

The farmhouse itself has a full complement of eight portable lamps and Pin-It-Ups totaling about 3,000 watts. In addition, there is an electric range, water heater (80 gal. storage), refrigerator, ironer, washer, dishwasher, coffee maker, kitchen mixer and vacuum cleaner.

In the milkhouse an eight-can milk cooler, an Esco sterilizer and an 80-gal. electric water heater are in use. Farm equipment in the barn consists of an I.H.C. milker, Bell hammer mill, Ireland hay hoist, Papec ensilage cutter and a Buffalo forge ventilating fan. Two electric pumps supply all the water for the entire farm. Mis-

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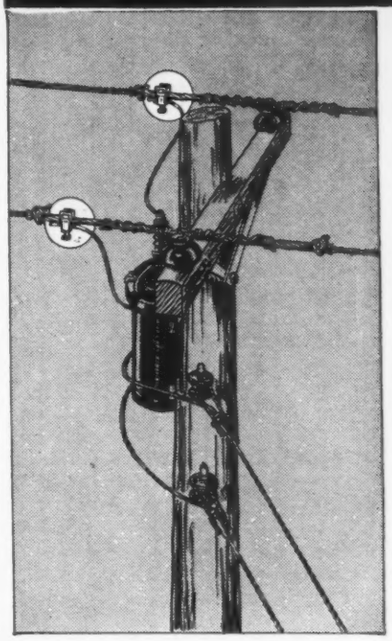

ACSR rural line transformer pole. Connections made over armor rods.

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For taps to ACSR over armor rods, or for grounding jumpers from neutral to guy wire, Reliable flip-on tap clamps are the answer. Very easy to install, low in cost, high in strength, and light in weight. Make fine mechanical and electrical joints without damaging the conductor or introducing corrosion problems.

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cellaneous equipment such as grinder, battery charger, electric drill and portable motor complete the equipment on the farm.

Since this farm is to be used as a proving ground it might be well to mention a few of the things we have learned so far from the experience with this project.

Kw. Demand Lowered

During the first few months of operation a maximum demand of 11.2 kw. occurred between 9 and 12 a.m. Attempts to reduce this by planning electric operations failed because of hired help, weather and interference with farm operations. Time control of water heaters improved the load factor and reduced the maximum demand from 11.2 kw. to 6.6 kw.

Below is a table of weekly demands before and after water heaters were controlled:

January, 1939 (Before Control)			January, 1940 (After Control)		
Max. Demand	Time	Kw.-Hr.	Max. Demand	Time	Kw.-H.
8.8	10 a.m.	334	6.0	8 p.m.	332
8.2	10 a.m.	314	5.2	10 p.m.	300
10.0	Noon	334	6.6	7 p.m.	362
9.2	Noon	350	6.2	7 p.m.	342

The milkhouse alone has used 11,700 kw.-hr. in two years, the milk cooler 2,525 kw.-hr. and 23,080 gal. of hot water have gone through the 80-gal. heater with 4,465 kw.-hr. used since April 11, 1939. Note that an average of fourteen cows have been electrically milked twice a day for about two years with a usage of only 1,219 kw.-hr. by the milking machine. Hot water is used to clean and to sterilize and in the winter is used to temper drinking water for calves, pigs and other stock.

I feel that many of us in the utility business may not fully appreciate the importance as well as the tremendous convenience of running water on the farm. Water pumping on this farm requires more kilowatt-hours than does all household refrigeration.

As to costs, it cost the Peets more than twice as much ($25 per year plus oil and repairs) to pump water by gasoline engine than it now costs with electric service. Of course, due to the constant supply and automatic control, the Peets not only use more water in the house but more hot water, a total of 40,000 gal. in two years, of which 17,830 gal. was hot water!

Some utility people may be surprised at the value to the customer and to the utility of a battery charger on the farm.

This single Peet farm, for example, uses its battery charger for the tractor lights, a truck, three automobiles and two spray rigs. Charging is mostly offpeak load and is a great convenience on the farm because filling stations are miles away and as Farmer Peet says: "You never know when a battery is down until it's down."

On this farm the customer declaims about his hay hoist, with its 5-hp. motor. This is a place where it is easy for farmhands to soldier on the job, says Farmer Peet. And on the farm, at the time hay is being hoisted, labor is very much in demand. Hay hoisting doesn't take too many kilowatt-hours, but when electric service replaces the gasoline tractor the saving on wear of the ropes dragging on the ground more than pays for the electric service, says Farmer Peet.

Further, with regard to farm motors, about which utility men have had a lot of discussion, we find this customer gets along nicely with a 5-hp. motor, a 2-hp. motor and a ¼-hp. motor for such uses as pumping tires, concrete mixing, for paint sprays, fruit grading and turning the grindstone.

Summary

Time studies before and after were most convincing to Mr. Peet of the value of electricity. It may sometimes be hard to get the farmer to place any value on time, convenience or dependability until he is real busy. We sometimes wonder if we are making enough use of this most effective selling tool.

Farm electric equipment must be installed properly and instruction given in its use if it is to give satisfaction.

It seems farmers as yet have only a vague understanding of electricity, its practical application, care and repair of equipment connected with its use. Experience on the Peet Farm has proved this. We are indebted to the Westinghouse Electric & Manufacturing Company for its contribution of this project for a better understanding of rural electrification.

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With at least five years of experience in connection with the design of electrical machinery; transformers particularly.

P-830, Electrical World
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(See also "Selling Opportunities Offered")

MAN with ten years' experience in electric power plant design and construction with emphasis on wiring design. Must have initiative and must be skilled in preparation of single line schematic and three line diagrams and coordinating them with conduit layout. Please furnish experience record and state salary desired. Location, Boston. P-818, Electrical World, 330 W. 42nd St., New York, N.Y.

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(Continued on the opposite page)